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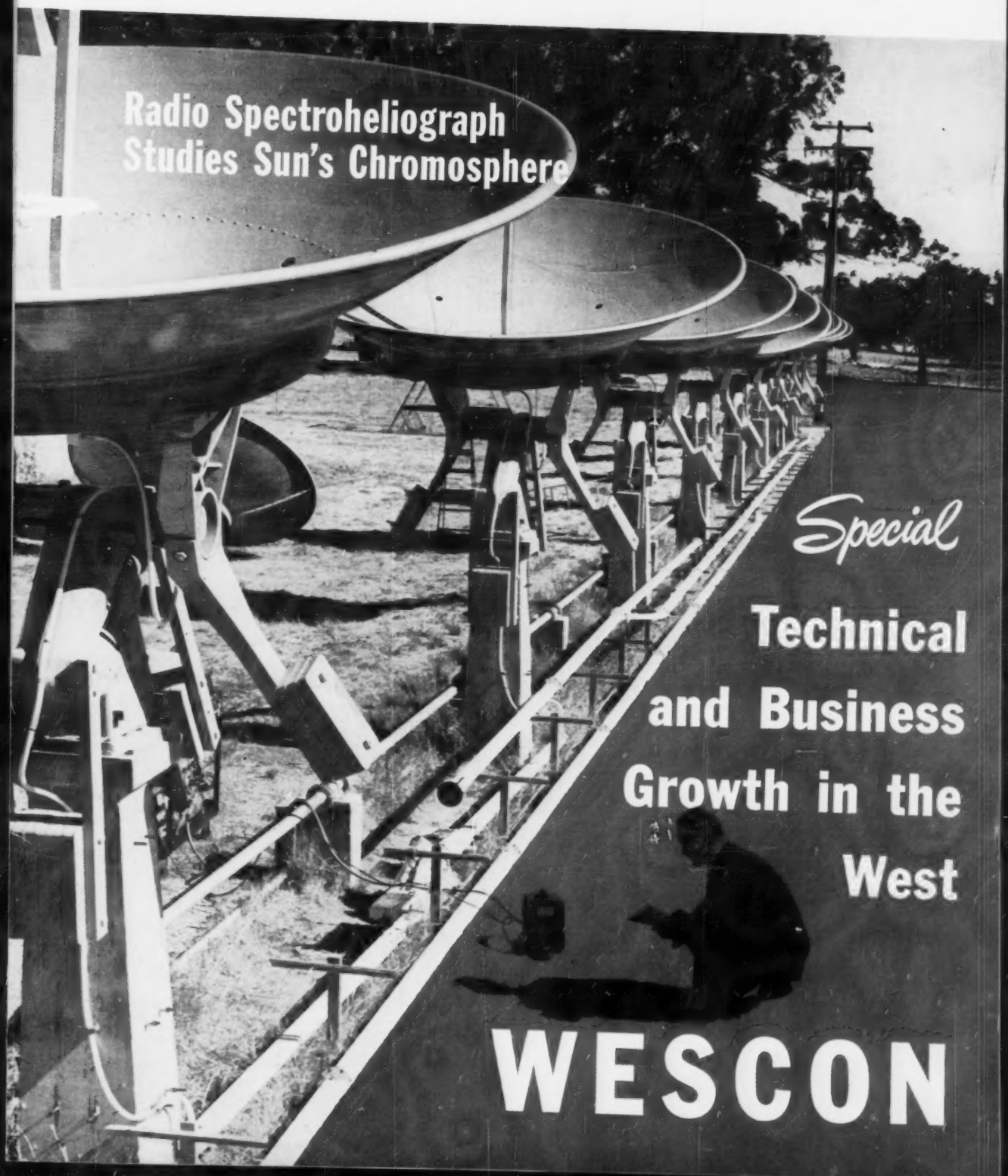

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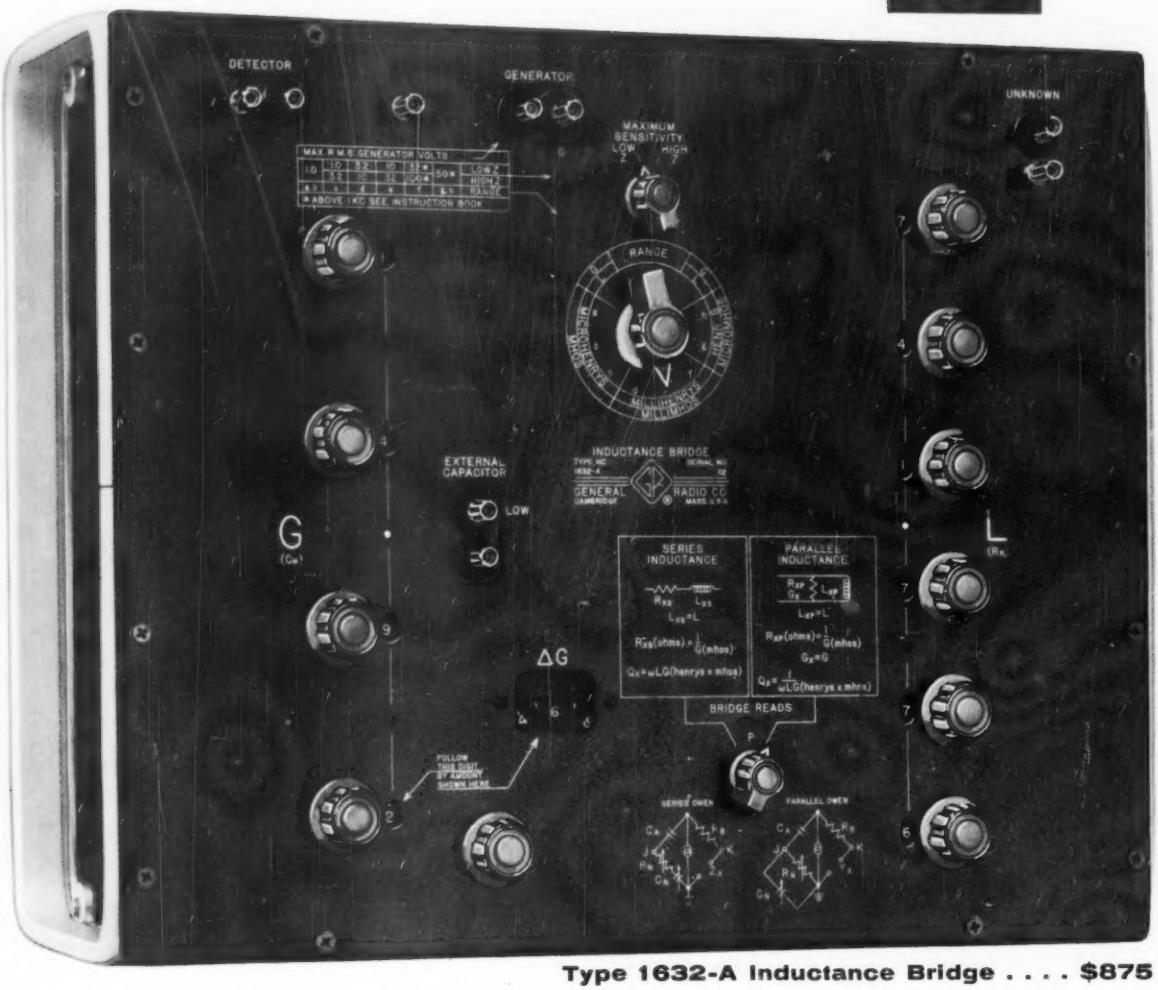

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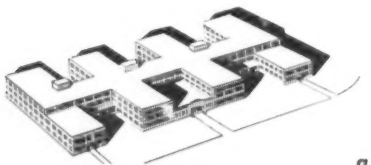

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Vol. 32 No. 32

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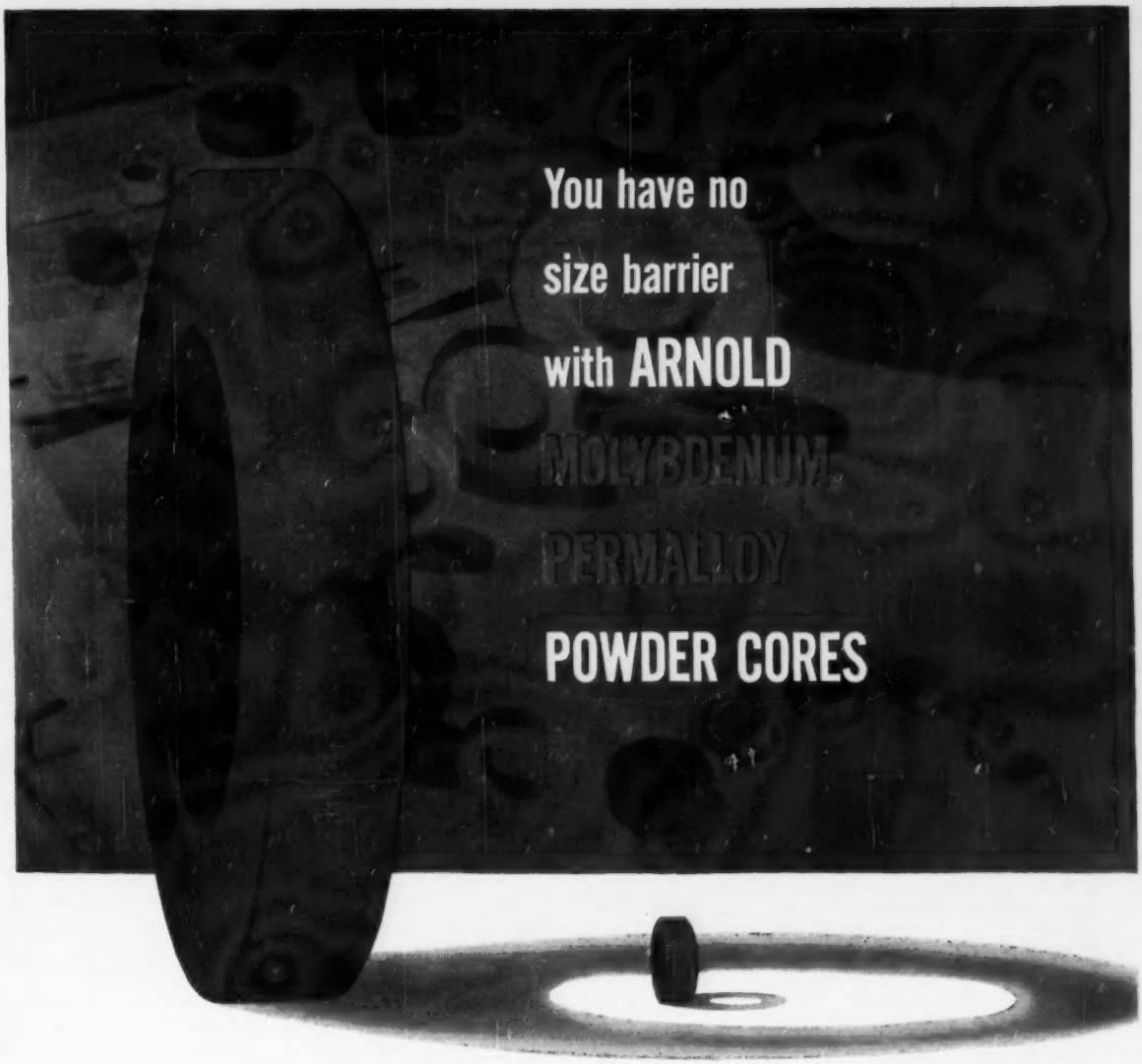

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WESCON COVERAGE. In less than two weeks, engineering and business leaders will be streaming into San Francisco's Cow Palace for the Western Electronics Show and Convention; among them you will find a heavy contingent from ELECTRONICS.

So far as news coverage is concerned, Pacific Coast Editor Hal Hood will be the heart of our operation. He spent much of July around the Peninsula working with committees, took the photo for this week's front cover, wrote the lead article "Technical and Business Growth in the West."

Working closely with Hal will be Howard Janis and Sam Weber, from the New York office. Howard will swing up to Portland and Seattle for a week after the Show. Sam will be looking around plants in the Los Angeles area for a week preceding it.

Home base August 18-21 for these three men in particular will be the McGraw-Hill booth, Number 2307.

Coming In Our August 14 Issue . . .

GUIDING THE X-15. Manned space flight poses a number of unusual electronics problems. The safe return of the pilot and the vehicle hinges on the accurate performance of flight data references. North American's experimental plane, the X-15, with test pilot Scott Crossfield at the controls, will soon be tested in the crucible of space at speeds approaching 3,600 miles per hour. At the altitudes and velocities of the flight path, conventional reference sensors are either inaccurate or impractical. Sperry Gyroscope's S. T. Cap and N. P. White describe the inertial reference system developed for the X-15. It uses precision accelerometers, gyroscopes and integrators connected in a Schuler loop.

ANTENNA SWITCHING AND PHASING. The problem of antenna location on aircraft is well known and the conventional method of correcting for the directional properties of the usual airborne antennas is to provide two or more with appropriate phasing and switching. I. Dlugatch of Space Technology Laboratories in Los Angeles has developed an automatic sensing device which greatly improves the efficiency and performance of phasing and switching systems.

TRANSISTOR SWEEP. There is much interest these days in transistorized tv sets. One of the problems has been in achieving a really efficient sweep with the power available. A deflection system described by Martin Fischman of Sylvania Research Laboratories in Bayside, N. Y., uses two transistors for the oscillator-driver and deflection high-voltage generator, and a single high-voltage rectifier tube for developing d-c. System uses diffused alloy power transistor for efficiency.

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		mA	μA	volts	25°C	150°C	25°C	150°C			mA	μA	volts	25°C	150°C	25°C	150°C
1N300	15	15	.001	10	0.001	2.0	65	18	**1N303B**	125	50	.01	100	0.1	14.0	65	20
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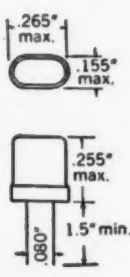
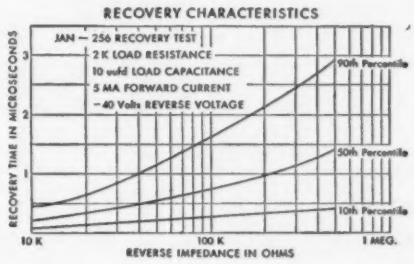
1N301	70	5	.01	50	0.05	8.0	45	12	**1N434B**	180	20	.01	150	0.1	18.0	60	20
1N301A	70	18	.01	50	0.05	8.0	65	20	**1N302**	225	1	.01	200	0.2	20.0	30	8
1N301B	70	50	.01	50	0.05	8.0	75	25	**1N302A**	225	5	.01	200	0.2	20.0	40	13
1N460	90	5	.01	75	0.1	10.0	45	12	**1N302B**	225	20	.01	200	0.2	20.0	55	20
1N460A	90	15	.01	75	0.1	10.0	60	18	**CK863**	300	1	.01	275	0.3	30.0	20	6
1N460B	90	50	.01	75	0.1	10.0	70	25	**CK863A**	300	3	.01	275	0.3	30.0	30	8
1N303	125	3	.01	100	0.1	14.0	40	10	**CK863B**	300	20	.01	275	0.3	30.0	50	15
1N303A	125	12	.01	100	0.1	14.0	55	16									

Ratings at 25°C unless otherwise indicated





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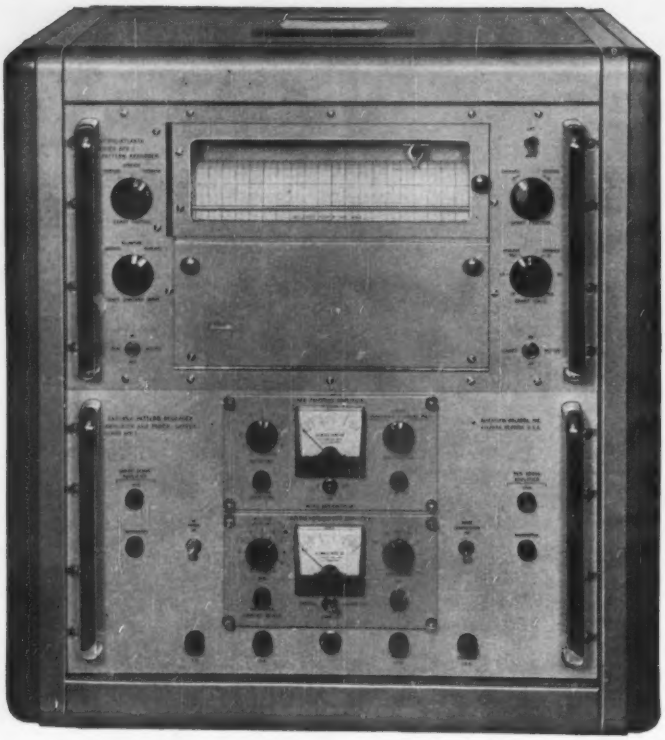

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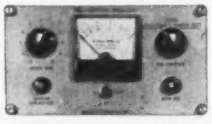

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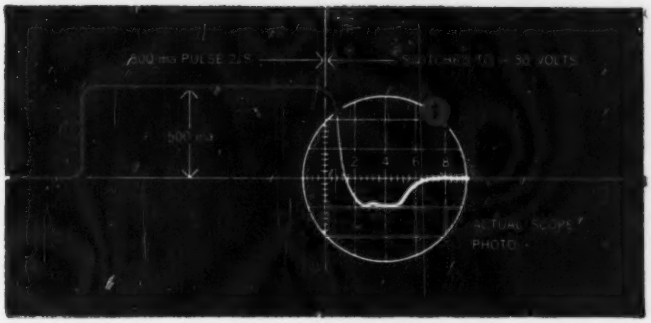

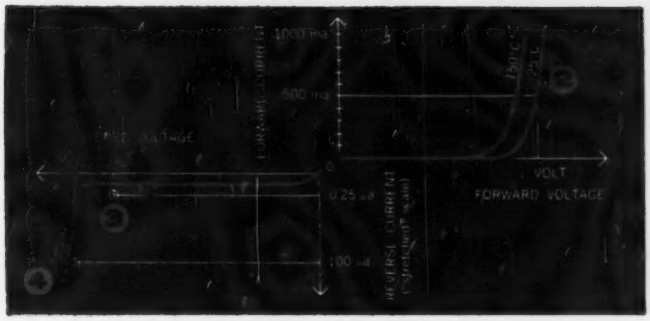

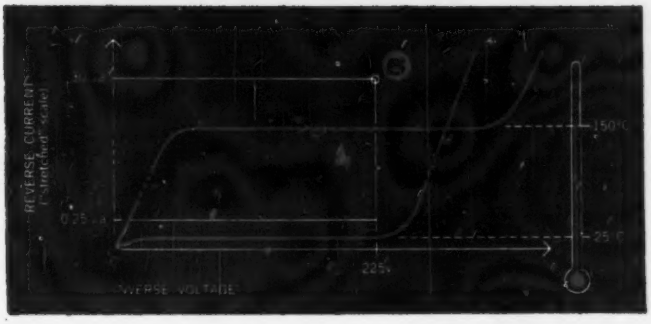

NEW FROM SPERRY is this high-temperature IN690 series silicon diode which gives you greater current-handling capability than germanium diodes – *with no sacrifice in recovery time!*

Check for yourself the performance characteristics of this new diode in the graphs at left . . . then compare them with our *minimum* specifications below.

- **FAST RECOVERY.** Maximum recovery time is 0.8 microseconds to return to 10 K ohms. Recovery test switches from a forward current 2 microsecond pulse of 500 ma, to a reverse voltage of −50 volts with a loop impedance of 1 K ohm.

- **HIGH FORWARD CONDUCTANCE.** The forward current specification is 400 ma at 25° C with 1.0 volt maximum drop under static (d-c) conditions. Conductivity increases with temperature – diagram shows typical "x-y" plots at 25° and 150° C.

- **LOW LEAKAGE** at high inverse voltage. Specification at 25° C is maximum 0.25 μa at rated voltages.

- **HIGH INVERSE VOLTAGE.** Saturation voltages can be supplied in a range from 40 to 150 volts for this high current series.

- **HIGH-TEMPERATURE OPERATION.** Typically, leakage current is no greater than 30 μa at working inverse voltage and 150° C. Diodes are rated for both operation and storage at temperatures from −65° to +150° C.

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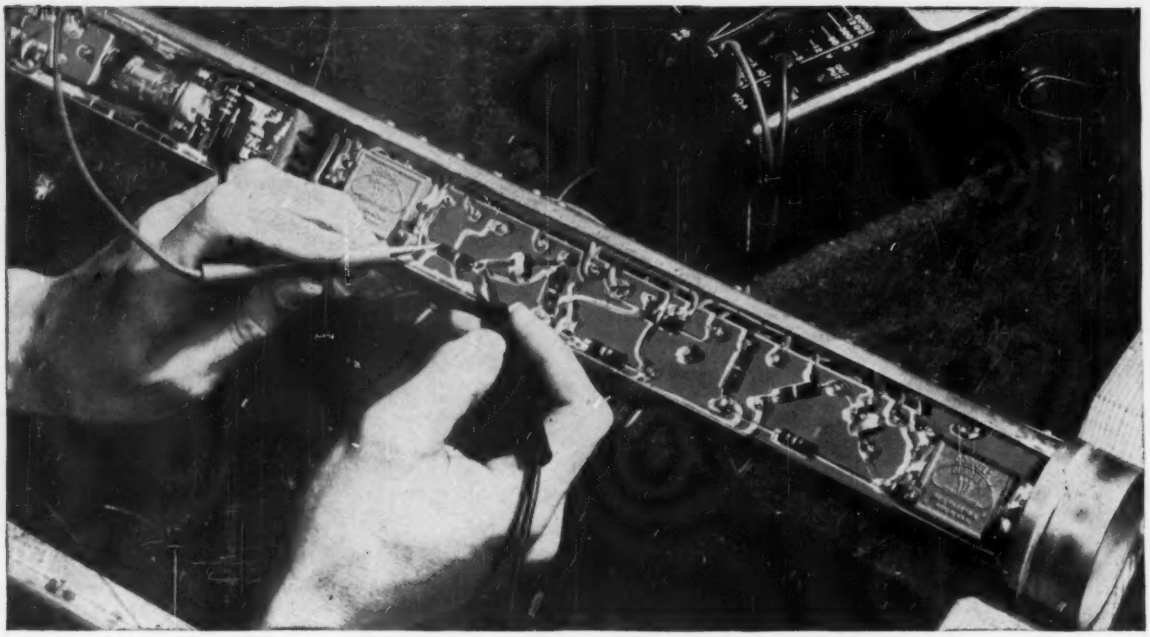
SILICONE NEWS from Dow Corning

Toward Greater Reliability



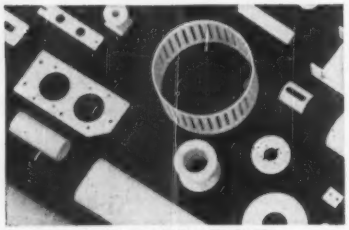
Silicone-Glass Laminate Proves More Dependable in Rough Environments

Schlumberger Well Surveying Corporation, makers and operators of geophysical well-logging instruments, found terminal boards of silicone-glass laminate more reliable in service and easier to fabricate. The instrument shown has a working range up to 191 C amid high humidity environments. In Schlumberger's evaluation tests, here's how a laminate based on Dow Corning silicone resins stacked up against other materials.

Silicone vs. phenolic: Silicone laminate had superior and more uniform dielectric properties at high environmental temperatures. Silicone laminate had lower moisture absorption: approximately 0.02% as compared with 2% for phenolic. Silicone laminate had much better dimensional stability than phenolic laminates.

Silicone vs. bonded mica sheeting: Once again, silicone-glass was chosen for its satisfactory dielectric characteristics. Silicone laminate also proved easier and less expensive to fabricate and install than mica because of mica's fragility.

Other plus properties of silicone-glass laminates include stability at 250 C, low loss factor, good physical strength, ease of fabrication, light weight, resistance to arcing, ozone and corona, and permissibility of adjacent soldering.



TYPICAL SILICONE LAMINATE PARTS

What all these add up to is greater reliability. If you are faced with the problem of engineering an electronic unit that will remain failure-free in difficult environments, investigate silicone-glass laminates. Manufacturers of quadradar sets, rotary switches, test chambers, and radio transmitters, to name but a few, have found these laminates meet or exceed their needs.

Here are some sample data:

Properties of Silicone-Glass Laminates

Property	Range
Flexural Strength, flatwise, psi, ⅛-inch thickness	
Lengthwise	20,000 - 40,000
Crosswise	18,000 - 33,000
Izod impact strength, edgewise, ft-lb per inch notch	
Lengthwise	6.5 - 17.0
Crosswise	5.5 - 14.0
Bonding strength, lbs., ½" thickness	
Condition A	650 - 1100
Condition D-48/50	550 - 950
Dielectric breakdown parallel to laminations, step-by-step test, kv.	
Condition A	32 - 50
Condition D-48/50	15 - 35
Dielectric constant at 1 megacycle, ⅛-inch thickness	
Condition A	3.90 - 4.20
Condition D-24/23	3.95 - 4.20
Dissipation factor at 1 megacycle, ⅛-inch thickness	
Condition A	.0015 - .003
Condition D-24/23	.008 - .022
Arc resistance, seconds	
Condition A	180 - 292
Condition D-48/50	180 - 248
Volume resistivity, meg-cm.	
Condition C-96/35/90	1×10^{1} - 4×10^{7}
Surface resistivity, megohms	
Condition C-96/35/90	10 - 10,000

first in silicones

Dow Corning CORPORATION

MIDLAND, MICHIGAN

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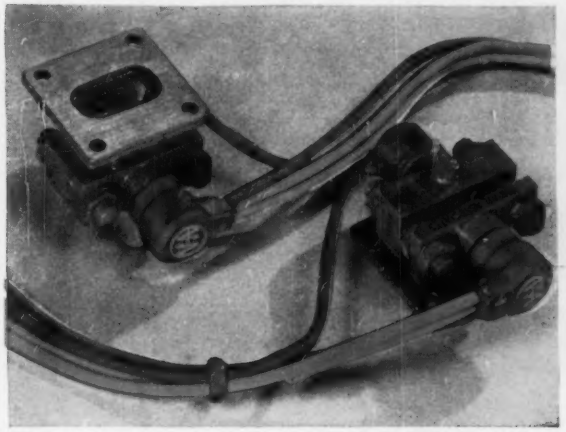
...silicones assure dependable components



Silastic Protects Against Corona, Humidity

This klystron tube for airborne radar utilizes Silastic®, the Dow Corning silicone rubber, to maintain frequency stability. Silastic moldings cover the tube's connections and lead wires, keeping out moistures and preventing corona. An excellent insulator, Silastic is unaffected by temperature extremes and ozone. Silastic retains its properties . . . can be relied upon to protect electronic gear in widely diverse and adverse environments.

In addition to its usefulness as a dielectric material, Silastic is often employed for purely physical reasons. Available in sponged or solid form, it protects delicate parts against shock and vibration. Silastic stays resilient from —90 to 260 C (—130 to 500 F), and resists the effects of extended storage, weathering, and corrosive atmospheres.

PHOTO COURTESY VARIAN ASSOCIATES

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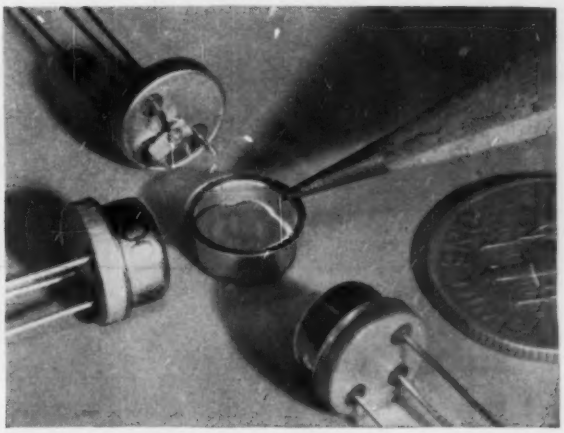
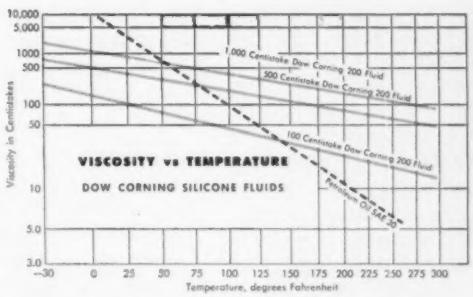


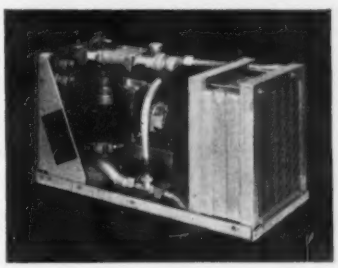
Grease-Like Silicones Boost Transistor Dependability... Dow Corning silicone compound is ideal for potting transistors. It seals out moisture and conducts heat away rapidly. In addition, it reduces rejection rates by preventing metal splatter from reaching the transistor wafers when caps are welded in place. These silicone compounds don't melt, don't thicken, and retain their excellent dielectric properties from —40 to 210 C. Industro Transistor Corporation, manufacturer of the units illustrated, finds the grease-like silicone materials help build a new degree of reliability into their product.

Actually, transistor potting is but one of the many jobs performed by Dow Corning silicone compounds. They seal out moisture at joints, on terminals, and in many other applications . . . preventing arcs, shorts, flashovers, corrosion, and contamination . . . assuring the performance of electronic units.

CIRCLE NO. 198 READER SERVICE CARD

Cooling Fluid with Reliable Flow Rate





Because of their thermal stability and relatively flat viscosity-temperature curves, Dow Corning silicone fluids make excellent heat exchange media. Silicone fluids maintain consistency over a range of —65 to 250 C. They can be pumped at high speed without suffering breakdown due to shear, have good lubricity, and will not oxidize or act as corrosives, despite contact with metals at high temperatures. In sum, they allow heat exchange units to operate uniformly and almost indefinitely, as far as the coolant is concerned.

Recognizing these factors, the Hallicrafters Company utilizes Dow Corning silicone fluid as the cooling medium in their new heat exchangers for electronic equipment. Specifically designed to cool airborne, shipboard, and ground support electronic equipment, the Hallicrafters units have ratings up to 7,000 watts dissipation, meet MIL specs.

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Your nearest Dow Corning office is your number one source for latest information and technical service on silicones.

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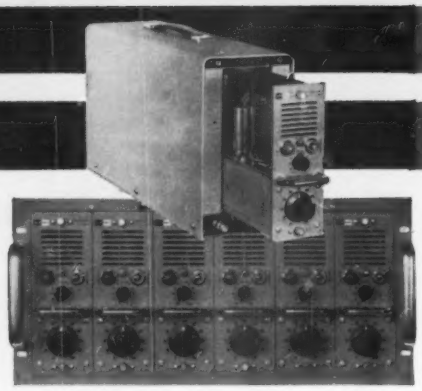
BUSINESS THIS WEEK



111BF DC amplifiers in Model 195 single-amplifier cabinet and Model 190 six-amplifier 19" rack module.

HERE'S WHY THE KIN TEL 111BF DC AMPLIFIER IS THE BASIC COMPONENT FOR ACCURATE, DRIFT-FREE AMPLIFICATION OF MICROVOLT-LEVEL SIGNALS:

KIN TEL 111BF DC wideband amplifiers allow extremely accurate measurement of dynamic physical phenomena such as strain, temperature, vibration, pressure, flow, torque, and displacement. They greatly simplify the design of data measurement systems, offering more bandwidth and accuracy, reduced maintenance, and none of the capacitive balance problems inherent in AC carrier equipment. KIN TEL's proved chopper amplifier circuitry with multiple feedback loops assures operational stability and uniform frequency response regardless of load or gain changes. The capability of providing full bandwidth and full output into large capacitive loads, at high gain settings, places virtually no restrictions on the type of output device that can be driven and allows the use of longer output cable runs.

The 111BFO, an operational version of the 111BF, has an open-loop position instead of a zero-gain position. In this position the user may employ external networks to provide up to 100% resistive or capacitive feedback around the amplifier, allowing its use as an integrator, active filter, or to generate complex linear transfer functions.

Many thousands of KIN TEL DC amplifiers, with millions of cumulative hours of operation, are in day-to-day use. Virtually all major missiles programs—including ICBM—employ KIN TEL DC amplifiers in ground support instrumentation.

- **Less than 2μv drift for 100's of hours**
- **DC – 40kc bandwidth**
- **0.1% gain stability**
- **$\pm$45v, $\pm$40ma output**
- **100kΩ input, $<$ 1Ω output impedance**
- **20 to 2000 gain**
- **Full output into 1μf loads**
- **Integral power supply**

Prices:

111BF DC Amplifier	$625
111BFO DC Amplifier	$635
195 Single-amplifier Cabinet	$125
190 Six-amplifier 19" Rack Module	$295

Immediate delivery from stock on reasonable quantities.

(Note: Amplifiers must be operated in 190 Module or 195 Cabinet.)

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ELECTRONICS NEWSLETTER

STEEL STRIKE—and the aluminum strike which may follow it—will probably not have any serious effect on the electronics industry unless it lasts through the summer. Horseback estimate indicates that most producers who use either metal stocked up in advance, are prepared to weather 60 to 90 days of short supply. After that, the pain.

STRATOSCOPE balloon-telescope flight on July 11 from Lake Elmo, Minn., sent a portable tv camera and transmitter aloft to 81,800 ft. Tv provided sighting data for crew on the ground, who aimed the balloon-borne telescope camera to take some of the "clearest (photos) ever taken of sunspots and of the magnetic area near sunspots." Radio command system enabled ground crew to focus, point and scan with the tv camera at will. Second flight in the current series of Stratoscope experiments was scheduled for early August, had not gone up as this issue went to press.

Russian videotape recorder may be tested this year. Izvestia reports that an experimental model of a "vision tape recorder" is being readied at the Kinmash factory in Leningrad, suggests it will be used for entertainment tv, computer systems, satellite and space vehicles.

UNORTHODOX APPROACHES to problems of defense against missile attack will be probed by Technical Operations, Burlington, Mass. Defense Department has given the firm $127,600 to study everything from countermissiles through "death rays" to antigravity.

JORDANIAN GOVERNMENT is studying an offer by Pye Ltd. of Britain to install Jordan's first tv station within six months. Firm reportedly will supply, erect, operate and maintain a 5-kw station with a radius covering Amman, the capital, and Jerusalem.

ULTRASONIC ENERGY provides possible source for controlling the burning rate of solid fuels in the coming generation of rockets. Acoustica Associates has an $85,188 contract from National Aeronautics & Space Administration to investigate feasibility of controlling thrust of the tricky solid propellants by varying the intensity of sound energy introduced into the combustion chamber.

INFRARED DETECTORS are used in new airborne V/H (velocity/height) computer to derive groundspeed data, control speed of film in aerial reconnaissance cameras. V/H computer is being developed by Avion division of ACF Industries, compensates for changing altitude to keep photos from smearing. Two scanners point toward ground, one slightly ahead of the other, providing data to compute true ground speed; film speed is servoed to compensate. Computer can control as many as six cameras. In navigational use, to derive either ground speed or drift, unit could steal a march on Doppler systems, since it cannot be detected by enemy ferrets.

Space vehicles for defense purposes will be made nonreflective to r-f energy so that they can hide in the sky on their journeys. Republic Aviation's new R&D center in Farmingdale, L. I., will try to find out how to do it as one of its first orders of business when it opens early next year.

BIOLOGICAL EFFECTS OF ELECTROMAGNETIC ENERGY will be explored at the 12th Annual Conference on Electrical Techniques in Medicine and Biology in Philadelphia, Nov. 10-12. Specialists will discuss the effects of microwaves, ultraviolet, ultrasonics and infrared. New medical electronic gear will also be shown and demonstrated. Deadline for papers is Sept. 15, says program chairman L. E. Flory, RCA Labs, Princeton, N. J.

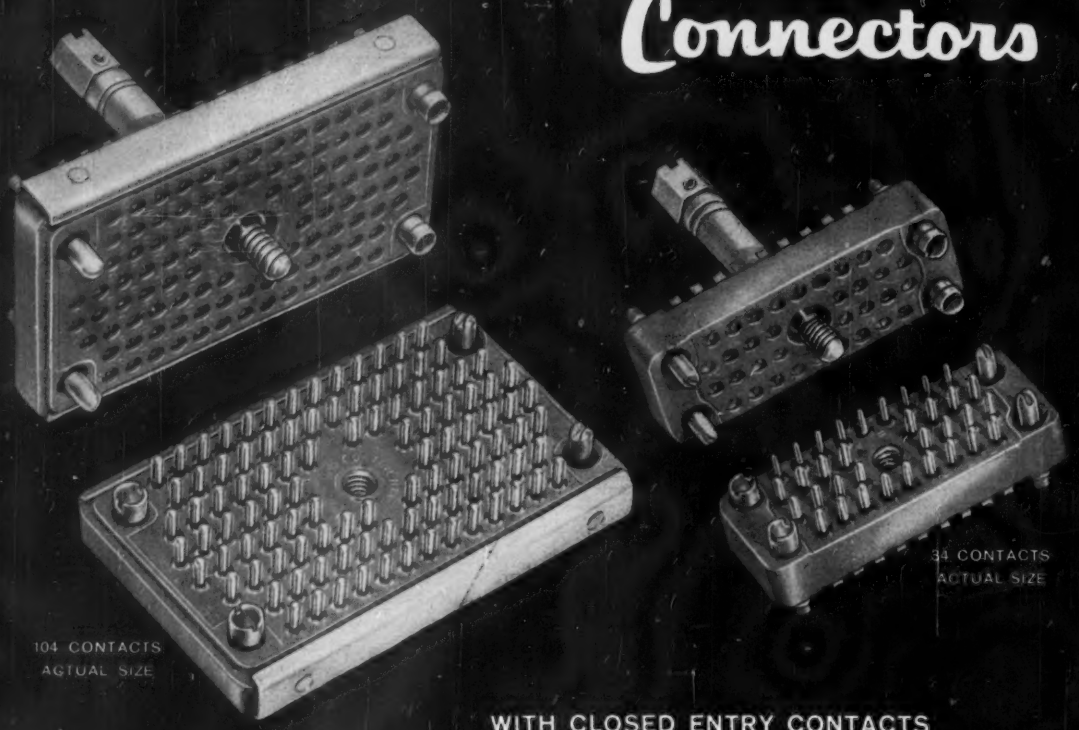
BIG DITCH traffic jams will be eased by electronic traffic cop. Panama Canal Co. contracts with Gibbs & Hill, New York engineering firm, to design a modern marine traffic control system which will use digital computers to schedule vessel transits. Modernizing project also adds new communications, including microwave relay to replace decades-old underground trans-isthmus cable. Also to be added: vhf radio net for pilots' administrative traffic, replacing visual control signals now in use; hyperbolic ranging system to track ships through the waterway. All electronic gear will be fully transistorized. Total bill for the modernization: $2 million.

Tactical air-to-surface missile may result from feasibility study now underway at Radiation Inc.'s Orlando, Fla., research division. Air Research & Development Command wants to find out whether a couple of advanced projects in this category are technically and economically feasible.

ELECTRIC EEL BATTERY for submarine cable repeaters has been developed by Aerojet-General Corp., Azusa, Calif., and the Signal R&D Labs at Fort Monmouth, N. J. Flexible zinc-silver chloride battery is 30 in. long, ¼ in. wide and becomes active when immersed in salt water.

New center screwlock connectors for heavy duty applications

from Continental Connectors



WITH CLOSED ENTRY CONTACTS

Continental's new center screwlock connectors are designed with high dielectric and mechanical strength for heavy duty applications in aircraft and electronic equipment. Features include a double lead thread screwlock, stainless steel reinforcing channels riveted to plug and receptacle, closed entry contacts and positive polarization through guide pins and sockets. At present the body is molded from glass filled Diallyl Phthalate, but other compounds as well as hoods and protective shells will be available soon.

Closed Entry Socket Contacts are spring temper Beryllium copper, gold plate over silver plate. They provide increased reliability and maintain a low millivolt drop under constant and uniform insertion pressure. Pin contacts are brass with gold plate over silver plate.

For full details on Continental's new Series 1900 center screwlock connectors, write DeJUR-Amsco Corporation, 45-01 Northern Boulevard, Long Island City 1, N. Y. (Exclusive Sales Agents)

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Crosley Radar

And . . . . . America's defense

Soon the latest in ground radar from Crosley will stand watch along the distant approaches to the North American continent. Since 1955 Crosley's radar engineers have been at work—designing, perfecting, improving this important new radar unit.

Now the FPS-26 ground radar is ready for production, and Avco's Crosley Division has been named prime contractor by the U. S. Air Force.

The huge radar—so new that it is still classified—will be housed in a radome more than 50 feet in diameter. It will be mounted atop a reinforced concrete tower more than 70 feet high and will consist of more than 300,000 parts, including some 3500 tubes and diodes.

Handling the design and production of complex, challenging radars is "old hat" to Crosley, prime contractor of the famous MPS-16 height finder radar now widely used by the armed forces. Similarly, Crosley now is prime contractor to the Air Force for the radar-directed fire control system that puts a 50-caliber "stinger" in the tail of the B-52 bomber.

Radar is just one example of Crosley know-how in both engineering and production—*designing* the best possible performance into the product . . . *producing* it on schedule, and at a reasonable cost.

Today Crosley is recognized as a leader, not only in radar, but in communications, marine electronics, electronic ground support, infrared, fire control systems, air traffic control, ordnance and missile arming and fuzing.

For more information, write to: Vice President, Marketing-Defense Products, Crosley Division, Avco Corporation, 1329 Arlington Street, Cincinnati 25, Ohio.

Avco / Crosley

ENGINEERS:

Creative research and development engineers experienced in electronics, mechanics, weapons systems, and ordnance warheads are urged to investigate the wide range of opportunity at Crosley. Write to: Director—Technical and Scientific Personnel, Dept. XXXX, Avco/Crosley, 1329 Arlington Street, Cincinnati 25, Ohio.

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WASHINGTON OUTLOOK

WASHINGTON—SEVERAL PROJECTS in which electronics figures prominently, such as the B-70, F-108, Dyna-Soar and antisubmarine projects, still in the design or early development stages and now ready to advance into the costly hardware stage, may suffer because of the Eisenhower administration's determination to mark its last year with a whopping federal budget surplus.

Budget economy is once more the byword as the Pentagon gets set to put together the defense budget for fiscal 1961 starting next July 1.

As a result, Pentagon officials will be forced to trim back or weed out several projects. For the Defense Dept. as a whole, this means an order not to hike total spending (which looks inevitable now as major development projects shape up) and to plan expenditures at this year's $41-billion level.

- **Senate Armed Services Subcommittee** under Sen. Strom Thurmond (D., S. C.) is going through the motions of taking up three major legislative proposals to overhaul military procurement laws. But congressional observers expect action to be deferred until next year.

  At that time, the special inquiry into military procurement policy, authorized in the recent Renegotiation Act extension, will begin—covering defense profits, contracting methods and military supervision over development and production.

  The senate proposals now being considered—introduced by Leverett Saltonstall, (R., Mass.); John J. Williams, (R., Del.); and Kenneth B. Keating and Jacob K. Javits (R., N. Y.) have contrary objectives.

  Saltonstall's bill would expand the role of the weapon system prime contractor, centralizing project authority even more than it is now and would simplify award of private negotiated contracts (as opposed to open advertised bidding). The other measures would place more restrictions on Pentagon-negotiated contracting as a means of spurring more advertised or competitive bidding.

  Proponents of the latter measures—and they appear to be in the congressional majority—hotly contend that weapon system contracting and negotiated contracting are antagonistic to the interests of smaller firms, that these practices lead to excessive costs and influence peddling.

- **The Pentagon, particularly the Air Force,** is reacting to such charges by watering down established contracting practices.

  The Air Force told the Thurmond subcommittee that it will stimulate competition by: (1) freezing design configurations and contracting directly with subsystem producers; (2) "breaking out" standard products such as electric generators, batteries, motors, compressors and launchers from a weapon system project for open bidding when volume production begins; and (3) conducting separate design competitions for electronic and other major subsystems.

  One example of the Air Force's about face in weapon system management comes in the WA-138A, the air-launched ballistic missile (ALBM). Douglas Aircraft, which bid for the development contract with a team of other companies, won the prime weapon system contract.

  General Electric was Douglas' bid partner for the electronics subsystem. In giving the award to Douglas, however, the Air Force rejected GE and ordered Douglas to conduct open competition on the subsystem.

  An Air Force official tells ELECTRONICS that this decision "reflects our inherent right to pick and choose on a team bid." But he conceded that the Air Force has "no specific criteria" to determine when individual members in a team proposal will be accepted.

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302A WAVE ANALYZER

Quick summary:

Covers 20 cps to 50 KC. Completely transistorized, no warm-up period. Ac powered, 3 watts consumption, hum free; or may be battery operated 18 or 28 v. Very sharp acceptance circuits; new operating ease without tedious lineup. Extremely compact, light weight.

SPECIFICATIONS

Frequency Range: 20 cps to 50 KC

Voltage Range: 10 μv to 300 v, 15 ranges

Warm-up Time: None

Voltage Accuracy: $\pm$ 5% of full scale

Residual Mod. & Hum: More than 75 db down

Intermediate Freq. Rejection: At least 75 db rejection

Selectivity: $\pm$ 3.5 cycle b.w., at least 3 db down
$\pm$ 25 cycle b.w., at least 50 db down
$\pm$ 70 cycle b.w., at least 80 db down

Input Impedance: 100,000 ohms on 4 most sensitive ranges; 1 megohm on others

Selected Frequency Output: 1 v open circuit. Response $\pm$ 1 db full range

B.F.O. Output: 1 v open circuit; output level control. Freq. response $\pm$ 1 db, full range. Output impedance approx. 600 ohms.

Auto. Freq. Control: $\pm$ 100 cycles holdin minimum

Price: $1,475.00 (cabinet); $1,460.00 (rack mount)

Data subject to change without notice.
Prices f.o.b. factory

Engineers have already termed the compact, transistorized hp 302A the most significant advance in wave analyzers in 10 years. Without time-consuming delay for warmup or calibration, the 302A instantly separates an input into its fundamental, harmonics and intermodulation products so that each may be examined individually. An AFC simplifies finding and holding a signal despite very sharp acceptance circuits.

Model 302A is highly useful in telemetering, carrier and vibration system work as well as audio applications. Ask your hp representative for a demonstration and specifications.

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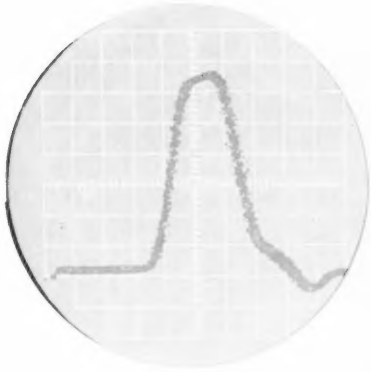

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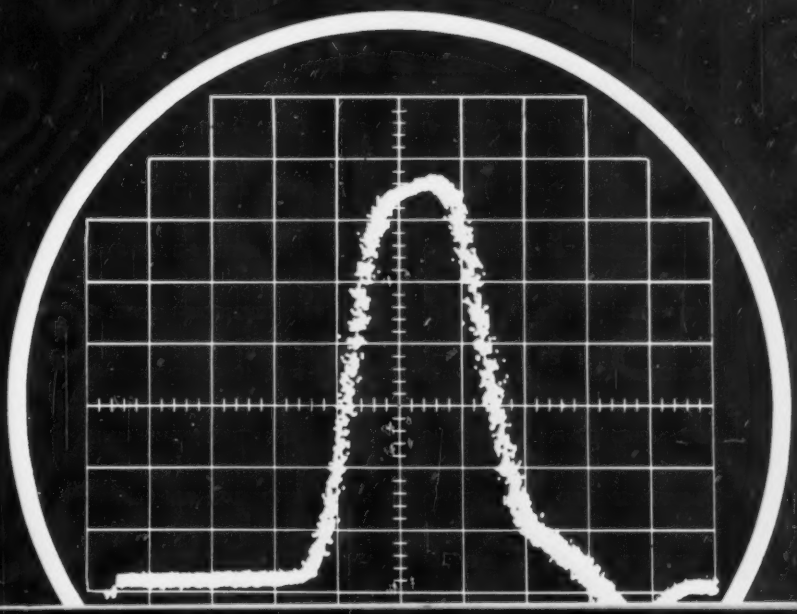
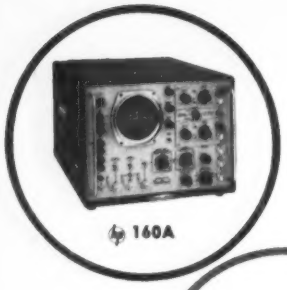
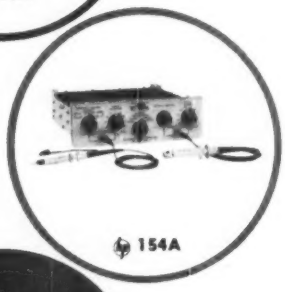
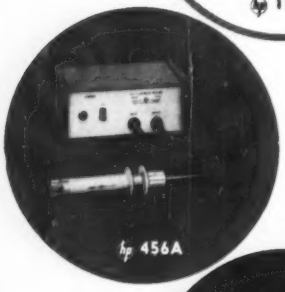
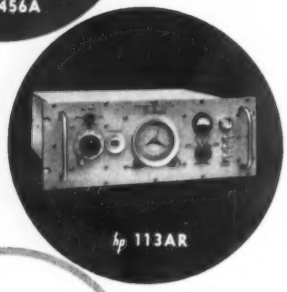


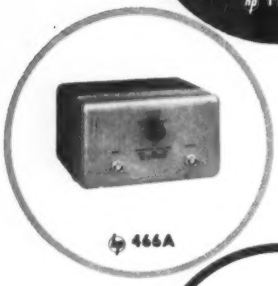
See all these at WESCON, or ask your hp rep for details

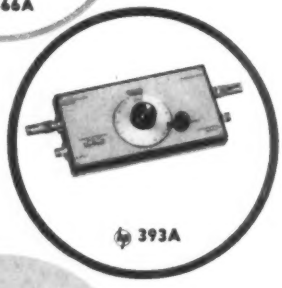


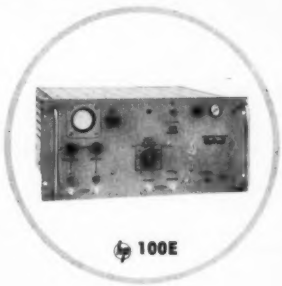












hp 160A 15 MC Oscilloscope. World's first high-frequency, high-performance oscilloscope built to military standards. Specifically designed for checkout consoles, field tests and other applications requiring extreme ruggedness and reliability. Broad 15 MC bandwidth, high 20 mv/cm sensitivity. Dual trace operation on alternate sweep or at a 1 MC chopping rate. Unique hp tube-transistor-tube circuit insures highest amplifier stability, minimizes heater cathode leakage and tube change effects, simplifies power supply circuitry, contributes to unique reliability. Regulated dc tube filament voltages further improve stability and tube life. Extra clean, compact, easy to service; uses improved etched circuitry on high quality epoxy impregnated fiberglass boards. Plug-in vertical amplifiers provide maximum scope usefulness.

hp 154A Voltage-Current Dual Channel Amplifier. Measures current qualitatively and quantitatively on oscilloscope by permitting direct viewing of ac current wave. Alternate amplifier presents ac or dc voltage wave in normal manner. Electronic switching by alternate sweeps or 100 KC chopper provides simultaneous viewing of both waves. Exclusive hp "current transformer" probe clamps *around* wire under test, requires no physical connection, does not load circuit under test.

hp 456A ac Current Probe. Permits measurement of current on indicating meters such as hp 400D, 400H or 400L VTVM's or oscilloscopes such as hp 120A, 122A, 130B. Exclusive hp "current transformer" probe clamps *around* wire under test, needs no physical connection, does not load circuit. Model 456A comprises battery-operated transistorized amplifier converting signals for direct VTVM reading of current. Range 1 ma to 2 amps. Accuracy 2%, frequency response 20 cps to 4 MC.

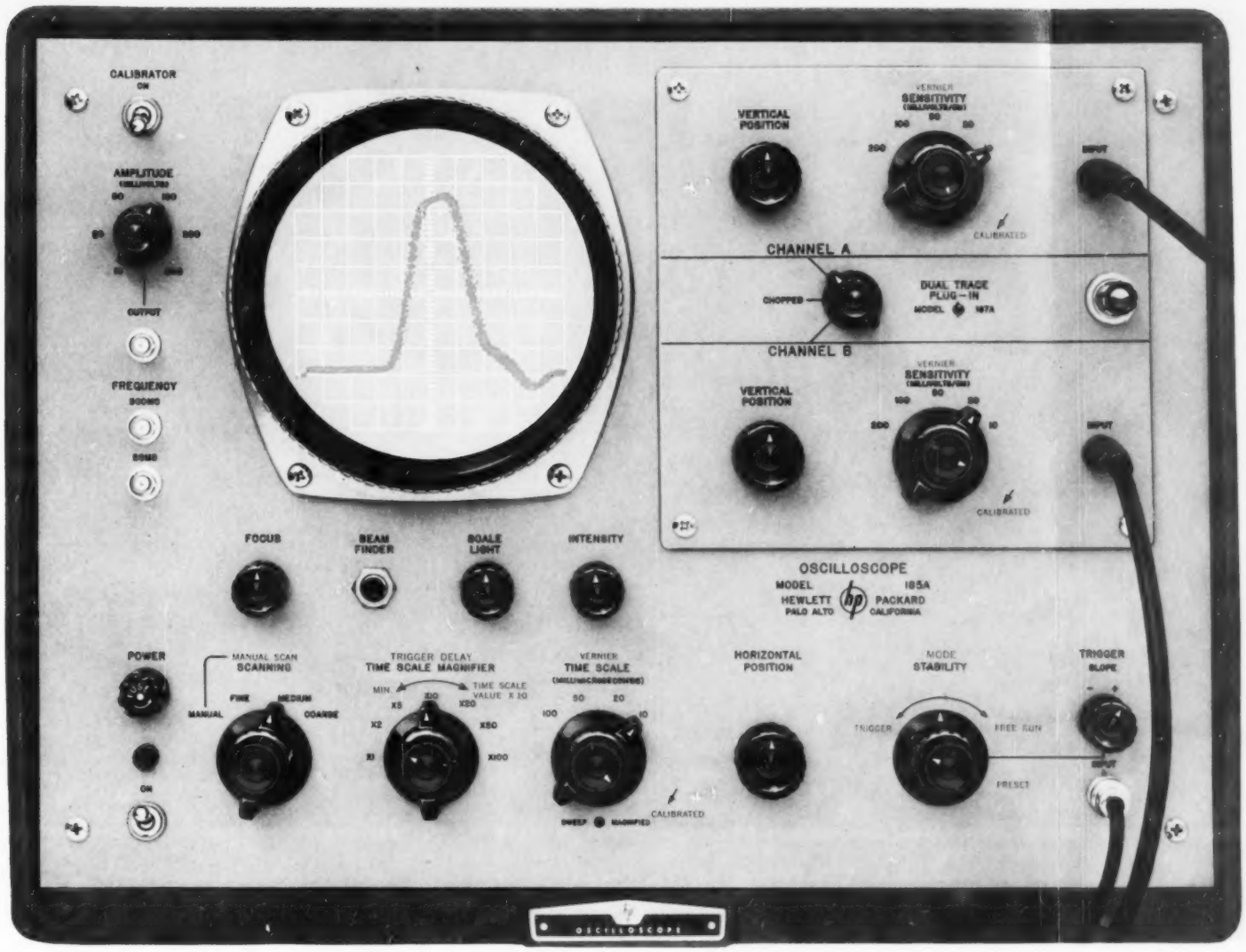
hp 113AR Frequency Divider and Clock. Precision time measuring instrument for comparing high stability oscillators and time signals with WWV and other standards. Compares on a time basis within 10 μsec (equals $1/10^8$ stability over 24 hours). Accepts 100 KC input; provides essentially jitter free 1 second tick output. Meets MIL-E-16400 for operation in extreme environment.

hp 466A Transistorized Amplifier. General-purpose instrument amplifier providing standard gains of 20, 40 and 60 db ± 0.2 db from 5 cps to 1 MC. Distortion less than 0.25%. Completely transistorized, rugged and compact, up to 400 hours continuous-duty operation without battery change.

hp 393A Variable Precision Attenuator. New two-in-one instrument. As precision attenuator covers 5 to 120 db; comes equipped with removable 50 ohm, 0.5 watt terminating resistors for most applications; also measures up to 200 watts with higher power terminations. Instrument also is a 4-terminal network for sampling power (replaces many fixed directional couplers) or coupling-isolating arrangements involving fixed oscillator, input and mixer. 500 to 1,000 MC, accuracy ± 1 db or ± 1.0%, whichever is greater. Unaffected by temperature or humidity.

hp 560A-95U Clock. Plug-in for hp 560A/561B Digital Recorders providing printed record on 3" tape of time data correlated with other phenomena. In-line 6 place numeric readout; maximum 23 hrs., 59 min., 59 sec. Internal time base, line frequency accuracy.

hp 100E Frequency Standard. Provides frequency stability of $5/10^8$. Makes conveniently available sinusoidal outputs of 10 cps, 100 cps, 1 KC, 10 KC, 100 KC and 1 MC. Rack mounted; panel only 8¾" high.



NEW-PRINCIPLE 500 MC SAMPLING OSCILLOSCOPE

Now you can view—clearly, steadily and brightly—on the new hp 185A Oscilloscope—repetitive short pulses requiring resolution up to 500 MC. Presentation is on a large, 5" cathode ray tube face; no optical magnification is needed.

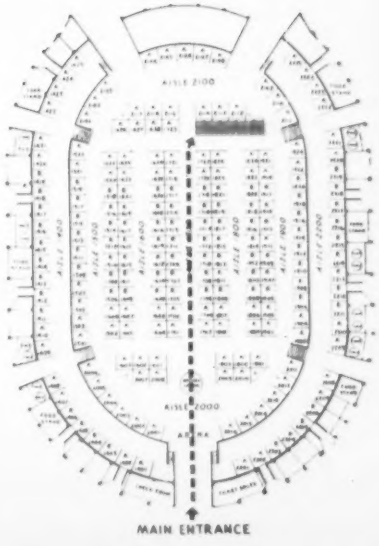
Calibrated sweeps are compatible with the bandwidth of the oscilloscope and vary from 1 millimicrosecond/cm to 100 millimicroseconds/cm. Rise time is approximately 0.7 millimicroseconds. A sweep delay control and magnifier provide a convenient means for synchronizing through an external trigger.

Model 185A displays very fast repetitive wave forms by "sampling" successive signals. Each "sample point" is delayed from the preceding sample an incrementally increasing amount so a different part of the signal is studied each time. After a pre-determined number of samples (50 to 1,000) the entire signal has been explored and the actual wave form recreated on the cathode ray tube face.

An outstanding feature of the hp 185A is a compact, new-concept probe arranged for easy application to the circuit under test and allowing a high impedance input. Calibrated sensitivity controls permit the instrument to accept a wide range of input voltages.

Other features include a dual-channel plug-in unit permitting simultaneous examination of two phenomena, an X–Y recorder output for permanent record, and a beam finder for added convenience.

Here's where to see and operate the new "500 MC" hp oscilloscope and other new hp instruments at WESCON

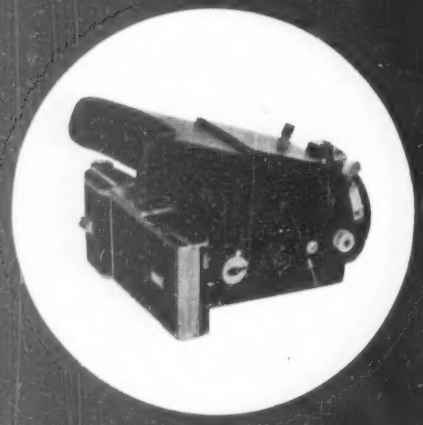


Turn page for more hp instruments you can see at WESCON

Other versatile new hp instruments you can see and test at WESCON!

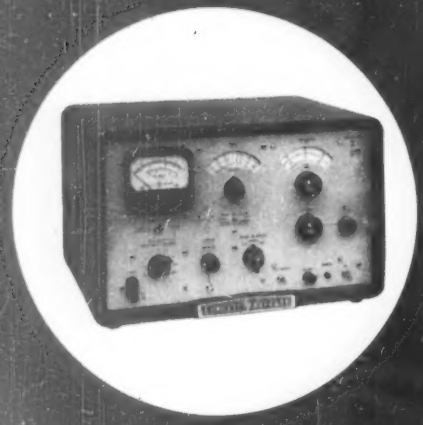
hp 523CR
Electronic Counter

Revolutionary, all-purpose counter measuring frequency 10 cps to 1.2 MC, time interval 1 μsec to 27.8 hours, period 0.00001 cps to 100 KC. Stability 2/1,000,000 per week. Direct, in-line readout; results displayed in sec, msec, μsec or KC; automatic decimal. Display time variable 0.1 sec to 10 sec or indefinite. Accuracy ± 1 count plus crystal stability, 5 gate times. Usable with 100 KC primary standard. High quality, completely self-contained. Pulse output for Z-axis oscilloscope modulation. (hp 523DR, similar but has neon column readout). hp 523CR, $1,485.00. hp 523DR, $1,285.00.



hp 196A
Oscilloscope Camera

Most convenient recording camera available. Object-to-image size ratio 1 to 0.9 views full 10 cm graticule width. One-hand mounting and multiple picture setting. Easy access to *f*-stop and shutter while camera mounted. Permits viewing image with both eyes, even when wearing eyeglasses. Employs Polaroid® Land Camera back. New Wollensak 3", f/1.9 lens has low distortion and high resolution. Weight only 9 lbs. $425.00.



hp 302A
Transistorized Wave Analyzer

New, completely transistorized, this advanced instrument provides direct, accurate wave component measurement without troublesome calibration or stabilization. Measurement range 20 cps to 50 KC. The instrument is hum free, requires little power, needs no warm-up, has very sharp acceptance circuits plus an AFC. May be battery-operated (18 to 28 volts). Extremely compact and convenient; easy to use, rugged, trouble-free. $1,475.00.

hp 403A
Transistorized ac Voltmeter

Battery-operated, portable, weighs less than 5 pounds. Transistorized, covers 1 cps to 1 MC and 100 μv to 300 v rms with maximum full scale sensitivity 1 mv. Also reads db direct from −12 to 2 db. 400 hours battery life (6 months average use); hum less than 30 μv on all but lowest range. Average-reading meter; accuracy ± 3% to 500 KC, ± 5% to 1 MC. Input impedance 2 megohms; high overload capacity. $250.00.

hp 428A
Clip-On dc Milliammeter

Radical approach to current measurement means no breaking of leads, no dc connections, no soldering, no circuit loading. "Current transformer" probe clamps *around* wire under test, measures by sampling magnetic field around the wire. Readily measures dc in the presence of strong ac. Covers 0.3 ma to 1 amp; accuracy ± 3%. $475.00.

hp 412A
Precision Volt-Ohm-Ammeter

A true, precision, multi-purpose instrument at last! Measures dc voltage 1 μv to 1,000 v with maximum full scale sensitivity 1 mv, full scale accuracy 1%. Measures currents 1 μa to 1 amp with ± 2% accuracy full scale (13 ranges). As ohmmeter, measures 0.02 ohms to 5,000 megohms. Low noise, low drift. Recorder output provides 1 v to 1 ma. $350.00.

For your convenience, hp is "center stage" at WESCON—at rear of main arena on your way to the technical meeting rooms.

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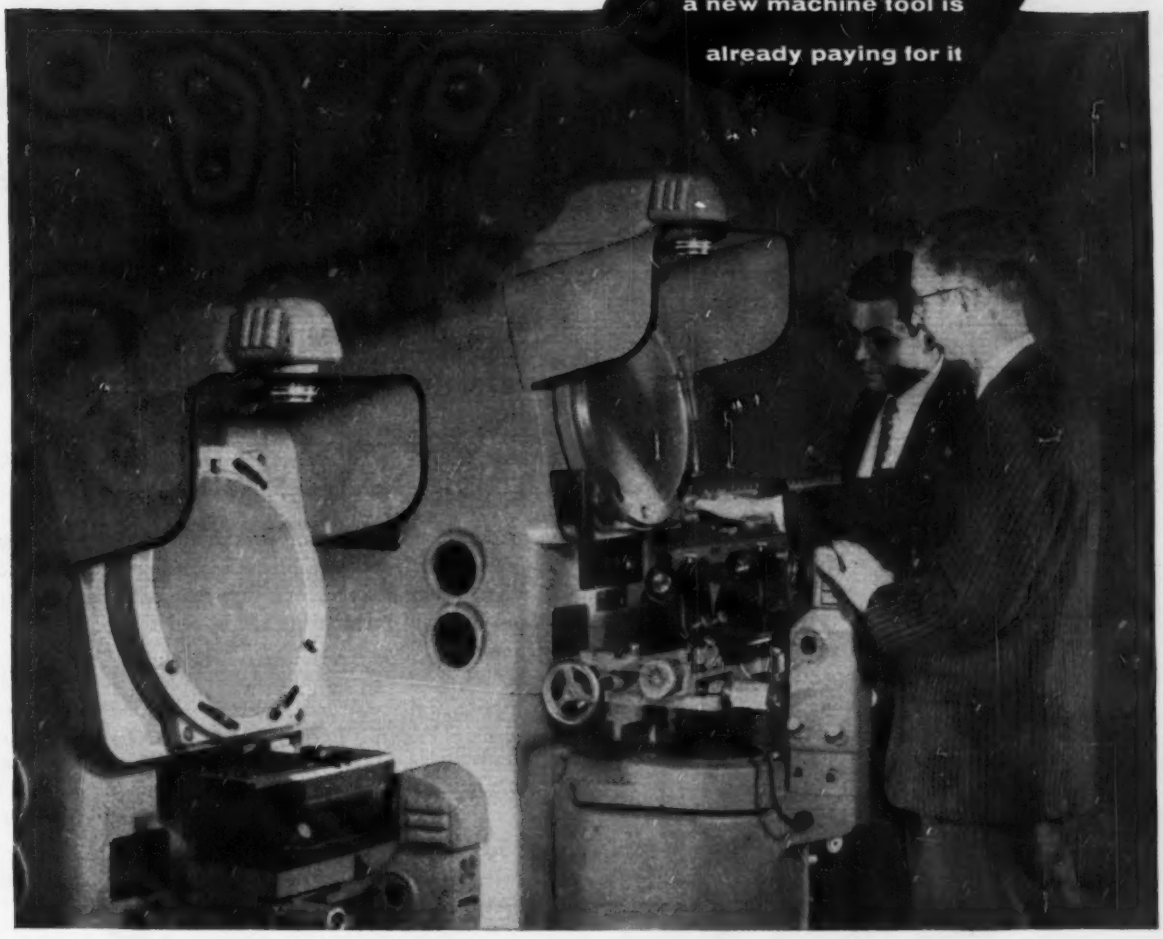
Hewlett-Packard S.A., Rue du Vieux Billard No. 1, Geneva, Switzerland

Cable "HEWPACKSA" • Tel. No. (022) 26.43.36

JONES & LAMSON OPTICAL COMPARATORS

the man who needs a new machine tool is already paying for it



This is what you should demand in an Optical Comparator

Optical inspection and measuring equipment offers fast operation, extreme accuracy and tremendous versatility. When buying a comparator, be sure you *get* these benefits:

1. Specifically designed *projection* lens system (not just an adaptation of *other* types of lenses).

2. Ball and roll type supported measuring tables (they offer top speed and accuracy).

3. Table assemblies so designed that simple changes can be made in your own plant. (You can change a basic *comparison* machine over to one for universal *measuring* applications, at low cost.)

4. Measuring facilities that offer direct readings without computation. (You save a lot of time, minimize human error, assure accuracy.)

5. Solid mechanical design throughout. (You can't inspect anything very accurately if it's moving.)

Jones & Lamson Optical Comparators and Measuring Machines give you all these features, plus many more. They are explained in detail in our new catalog. Write for a copy today. Jones & Lamson Machine Company, 539 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

←CIRCLE NO. 22 READER SERVICE CARD

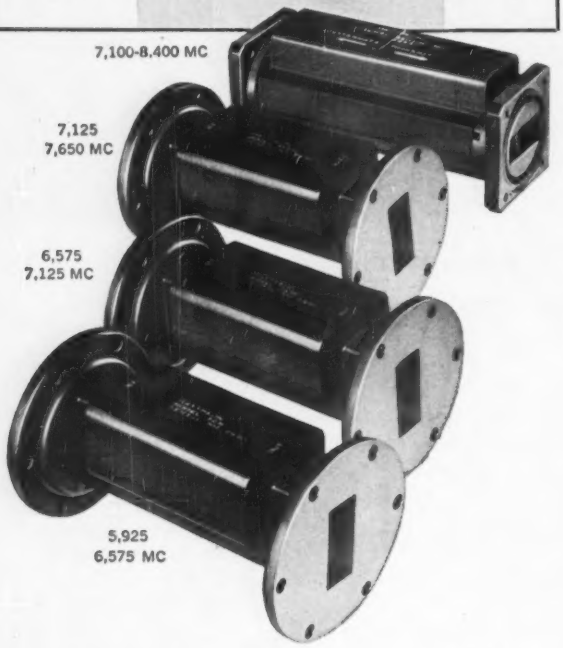
CIRCLE NO. 23 READER SERVICE CARD

RECENT RAYTHEON DEVELOPMENTS
IN MICROWAVE FERRITE DEVICES

ISOLATORS FOR COMMERCIAL AND GOVERNMENT BANDS

TYPICAL SPECIFICATIONS

	ICM13	ICM12	ICM21	ICM22
Freq. range (mc)	5,925-6,575	6,575-7,125	7,125-7,650	7,100-8,400
Isolation				
Minimum	43 db	42 db	42 db	40 db
Maximum	54 db	57 db	50 db	60 db
Insertion loss				
Minimum	0.6 db	0.75 db	0.6 db	0.5 db
Maximum	0.7 db	0.85 db	0.7 db	0.8 db
Power Average	10 watts	10 watts	10 watts	100 watts
VSWR				
Minimum	1.03 db	1.07 db	1.05 db	1.08 db
Maximum	1.15 db	1.15 db	1.09 db	1.19 db
Weight (max.)	2.6 lbs	2.6 lbs	2.6 lbs	4.0 lbs
Max. dimension	5.0 in.	5.0 in.	5.0 in.	5.0 in.
Flanges	UG-344/U	UG-344/U	UG-344/U	UG-51/U
Waveguide	RG-50/U	RG-50/U	RG-50/U	RG-51/U



THREE REPLACE TEN. These three isolators cover C-band frequencies in both government and commercial bands—5,925-7,650 mc. A fourth unit covers the entire range from 7,100-8,400 mc.

THREE C-BAND UNITS OFFER MAXIMUM PERFORMANCE FROM 5925-7650 MC

Three isolators where ten were formerly needed!

Advanced development work at Raytheon now allows greater interchangeability of isolator parts, simplifies the stocking of spares for system requirements and offers a significant price advantage in ordering.

The three units, designated ICM13, ICM12, ICM21, cover the frequencies from 5,925-7,650 mc in three steps—5,925-6,575, 6,575-7,125, and 7,125-7,650 mc respectively. Maximum insertion loss is less than 1 db; minimum isolation is 40 db. Maximum VSWR is 1.15 for the ICM12 and ICM13 and 1.10 for the ICM21.

A fourth unit—the ICM22—covers the entire range from 7,100-8,400 mc (see specifications at left).

To learn more about this significant development or other important Raytheon advances in microwave ferrite devices, please write, stating your particular requirement, to the address below.

RAYTHEON COMPANY
SPECIAL MICROWAVE DEVICES, WALTHAM, MASS.

RAYTHEON *Excellence in Electronics*

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SEMICONDUCTOR
POWER SUPPLIES...

Here's reliability . . . Since their introduction, over 18 months ago, not one Regatran has lost a series transistor due to short circuits or overloading.

- transistorized
- short circuit proof
- super-regulated
- overload protected
- low output impedance
- lowest ripple
- high-speed regulation
- null balance control
- sensing terminations
- front panel calibration
- any grounding arrangement
- small size, light weight

Regatran Semiconductor Power Supplies are available in various ratings up to 0 to 60 V dc and 0 to 30 amperes, depending on model. Write for Bulletin 721.

SEE THEM AT WESCON BOOTH 323

ELECTRONIC MEASUREMENTS
COMPANY OF RED BANK
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One Million Twists

RESEARCH IN DEPTH Proves Performance of Mallory Controls

In terms of the service they can normally expect, the Mallory volume controls on the test machine pictured on the opposite page are several hundred years old . . . and still going strong.

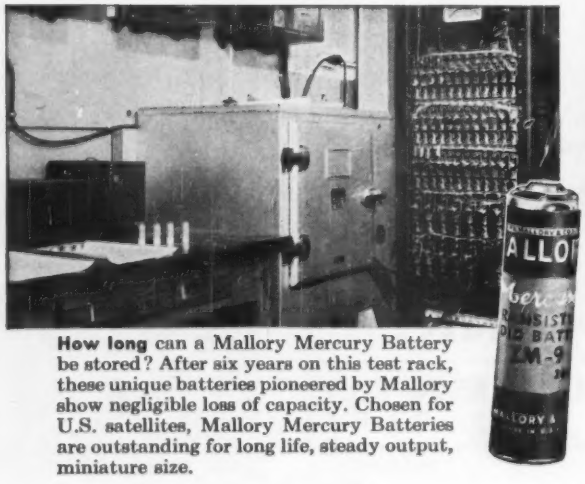
This group of random samples from our production went through *one million rotational cycles* without breakdown. In a radio or TV set which gets turned on and off ten times daily, a million cycles is the equivalent of centuries of service.

Usual specifications for controls call for life of ten to twenty-five thousand cycles. To make sure that Mallory controls have ample extra life built into them, we constantly run more extensive endurance and environmental tests . . . in addition to the final production checks that every component receives. Years of correlation between field service, statistical sampling tests and 100% inspection assure you that every Mallory control will meet or exceed your reliability standards.

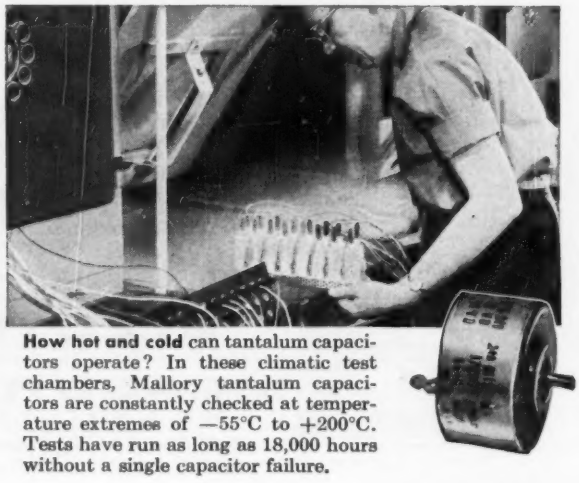
A principal reason for the reliability of Mallory controls is the high-density carbon element, which gives unequalled stability, low noise and long life. Like other "plus" features of Mallory components, it was created by "Research in Depth" . . . the teamwork of basic research in our Corporate Laboratories and intensive development by our manufacturing organizations. And it was verified by Mallory "Testing in Depth," which puts components through far more rigorous service than they will ever get in the field.

From this policy comes continuing progress in controls, capacitors, resistors, vibrators, rectifiers, batteries, and related components . . . the better-than-ever building blocks for tomorrow's electronics.

Mallory Research in Depth Assures

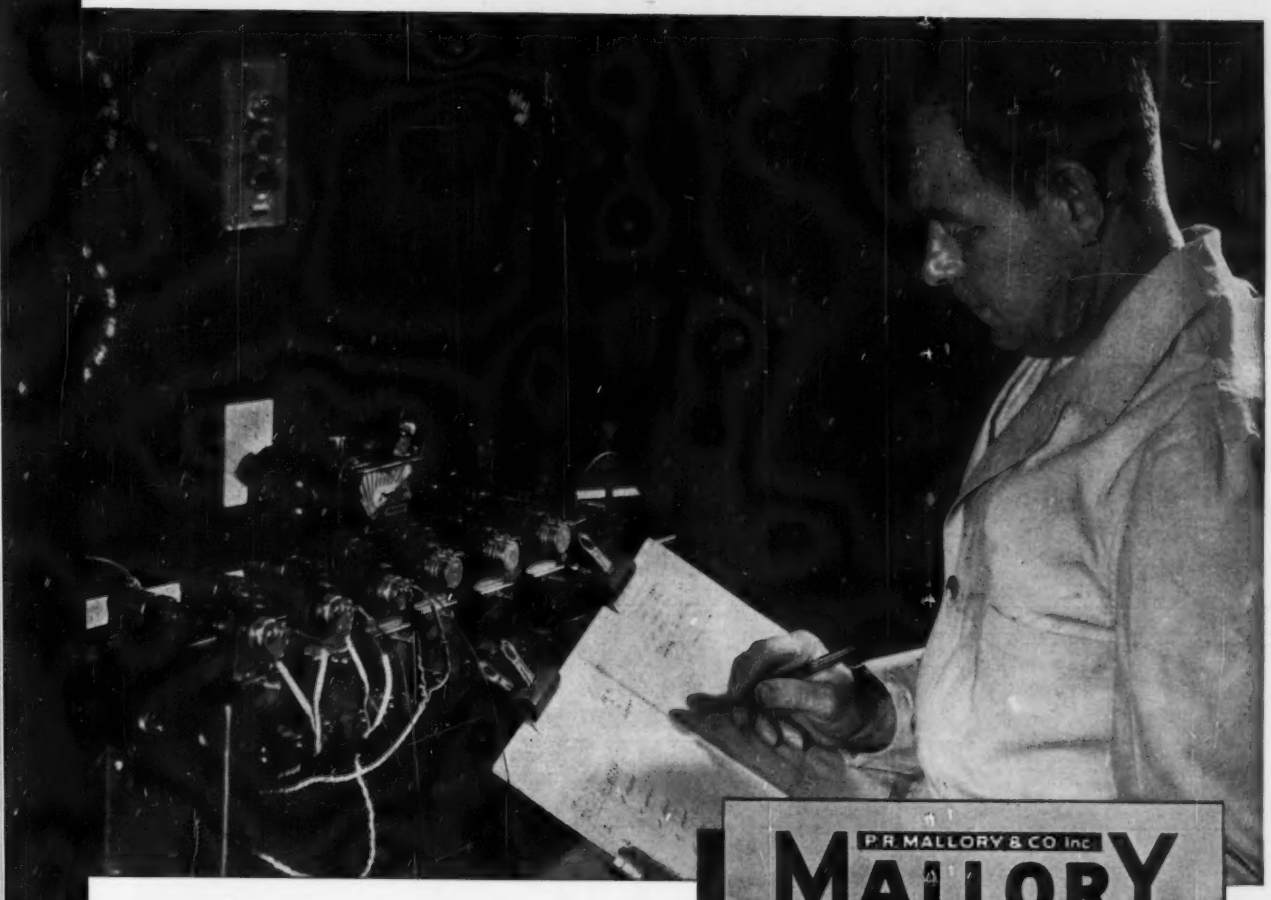


How long can a Mallory Mercury Battery be stored? After six years on this test rack, these unique batteries pioneered by Mallory show negligible loss of capacity. Chosen for U.S. satellites, Mallory Mercury Batteries are outstanding for long life, steady output, miniature size.

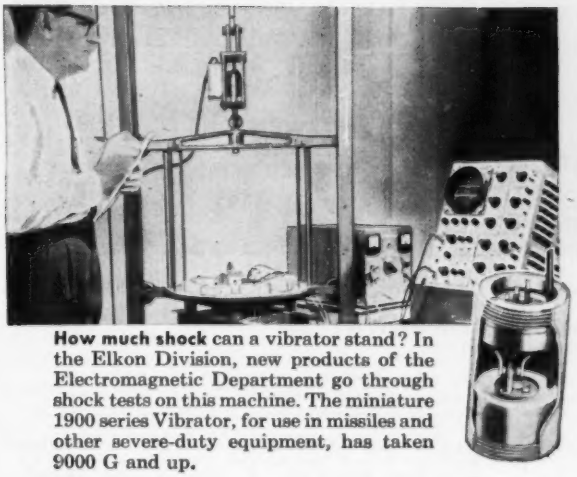


How hot and cold can tantalum capacitors operate? In these climatic test chambers, Mallory tantalum capacitors are constantly checked at temperature extremes of −55°C to +200°C. Tests have run as long as 18,000 hours without a single capacitor failure.

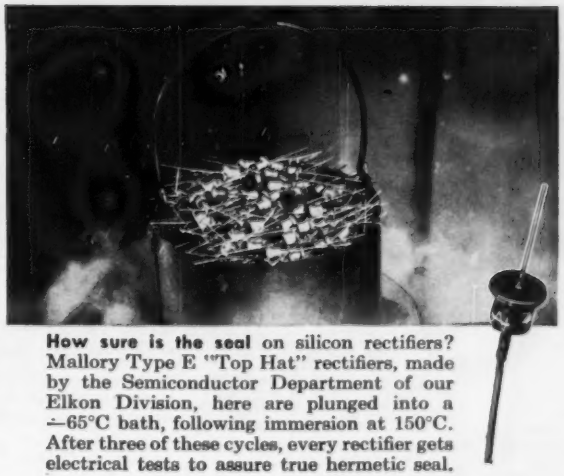
# of The Knob



Reliability



How much shock can a vibrator stand? In the Elkon Division, new products of the Electromagnetic Department go through shock tests on this machine. The miniature 1900 series Vibrator, for use in missiles and other severe-duty equipment, has taken 9000 G and up.

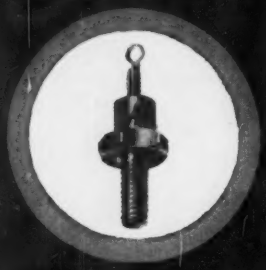


How sure is the seal on silicon rectifiers? Mallory Type E "Top Hat" rectifiers, made by the Semiconductor Department of our Elkon Division, here are plunged into a −65°C bath, following immersion at 150°C. After three of these cycles, every rectifier gets electrical tests to assure true hermetic seal.

CIRCLE NO. 27 READER SERVICE CARD

GENERAL INSTRUMENT SEMICONDUCTOR DIVISION

NOW...



10 AMPS in a 1 AMP package!

AUTOMATIC
DIFFUSED HIGH POWER SILICON RECTIFIERS

COMPLETE RELIABILITY AND TOP EFFICIENCY WITH LOW FORWARD DROP AND PIV UP TO 600V...

ABSOLUTE MAXIMUM RATINGS (FOR 150° C. CASE)	AG 0512	AG 1012	AG 1512	AG 2012	AG 2512	AG 3012	AG 4012	AG 5012	AG 6012
PIV, Volts	50	100	150	200	250	300	400	500	600
Cont. DC Rev. Working Volt., Volts	50	100	150	200	250	300	400	500	600
Av. DC Output Cur., Amps	10	10	10	10	10	10	10	10	10
Peak Recur. Fwd. Cur., Amps	45	45	45	45	45	45	45	45	45
Surge Cur. (1/120 Sec.), Amps	200	200	200	200	200	200	200	200	200
Fwd. Volt. Drop (DC)*, Volts	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Rev. Cur. @ Rated PIV, Ma	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

*Measured at 25° C. at 25 amperes.
Average over one cycle for full wave choke input or resistive circuit, with rectifier operating at full rated current.

A triumph of miniaturization, these AUTOMATIC rectifiers give you a smaller stud package with *ten times* the power you'd normally expect, and can also be supplied with reverse polarity. Rugged, reliable and truly versatile, they fill an important need in the field of semiconductors. Complete data sheets are available upon request.

Semiconductor Division

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65 Gouverneur Street, Newark 4, N. J.

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U.S. Capital Looks Abroad

U. S. ELECTRONICS FIRMS seeking sound financial prospects are looking overseas with increased interest. Some examples of activity along these lines:

• **Nucleonics, Chemistry & Electronics Shares Inc.,** New York mutual investment fund, is exploring the European area for sound growth stocks for its portfolio. The fund now carries almost $200,000 worth of stock in N. V. Philip's Gloelampenfabrieken, Netherlands, and about $330,000 worth of stock in Siemens & Halske A.G. in Germany.

NCE also has recently purchased 1,500 shares of Farbwerke Hoechst A.G. in Germany. In addition, the portfolio includes securities of several British and Canadian firms.

J. M. Templeton, NCE's president, said the fund would continue to search out investment opportunities. NCE is now evaluating a tax treaty between the U. S. and Japan in which, Templeton notes, Japan will hold no tax on dividends. He points out the best growth in Japanese economy includes electronics, electrical gear, autos and drugs. Fund's net assets stood at $6 million at the end of June.

• **American Bosch Arma,** Hempstead, N. Y., announces that licensing negotiations are in progress with the French firm of Association des Ouvriers en Instruments de Precision, Paris. The French firm, which manufactures communications equipment and instruments, will produce Arma gyroscopes. It will work closely with S. G. Brown, Ltd. of England, which was licensed by Arma last year.

• **Minnesota Mining & Manufacturing** is urging passage of a bill before the House Ways and Means Committee. The bill is designed to encourage greater investment of private American capital overseas through tax incentives. J. L. Connolly, general counsel for 3-M, says his firm is convinced that increased capital investment in underdeveloped areas will reflect to the advantage of the American economy. He thinks the present tax structure, as it affects foreign operations of American firms, discourages investment in underdeveloped areas, even though the State Department is trying to encourage such investment.

• **Avien, Inc,** Woodside, N. Y., is in the news on the domestic scene with the announcement that the firm has been admitted to listing on the American Stock Exchange. Trading symbol for the new listing is AVN. The class A capital stock of the company had previously been traded over the counter. Avien sales for the fiscal year ended June 30 were reported at $7,398,000, up 14 percent from the same period last year.

• **Hewlett-Packard,** Palo Alto, Calif., has approved merger plans with **Dymec, Inc.,** in the same city. Dymec was founded in 1956 and manufactures instrumentation systems, radar simulators and digital devices for instrumentation systems. Current annual sales top $3 million.

25 MOST ACTIVE STOCKS

WEEK ENDING JULY 24

	SHARES (IN 100's)	HIGH	LOW	CLOSE
Reeves Soundcrft	1,449	12⅜	9¼	10
Gen Tel & Elec	1,312	78⅞	70¾	78
Sperry Rand	987	26⅛	24⅞	25⅞
Lear	900	17	14	16⅝
Intl Tel & Tel	676	39⅛	36¾	38⅝
Victoreen Inst	665	19½	16⅛	17⅝
Avco Corp	626	15⅜	14½	15
Cons Electrodnmcs	563	45½	40⅝	44⅜
Gen Elec	542	81⅞	80⅝	81¼
Gen Dynamics	510	52⅝	51	51⅝
Beckman	455	68⅛	66	67⅛
Herold Rad & Elec	449	10⅝	9	9⅞
Raytheon	447	55⅜	52¾	53
RCA	433	68⅞	67	67⅝
Muter Co	422	10⅞	8¼	9⅝
Ampex	414	86	78¼	82¾
Univ Control	351	18¾	17¾	18
Magnavox	330	68¾	59¼	68½
Westinghouse	328	95¼	88½	94
Philco	327	30⅞	27⅝	28⅞
Standard Coil	308	19⅝	17¾	18⅝
Burroughs	299	37⅛	35⅛	35⅜
Cons Elec Ind	296	53	48¼	50⅛
Intl Resistance	294	20⅜	17¼	17¾
Emerson Radio	291	19⅜	18⅛	18⅜

The above figures represent sales of electronics stocks on the New York and American Stock Exchanges. Listings are prepared exclusively for ELECTRONICS by Ira Haupt & Co.

ROYAL "FOAMAX" CABLES

Maximum reliability is built into every foot of "Foamax" — Royal's new Foam Dielectric Cable, manufactured to meet highest quality and performance standards. Write for a sample length and technical data.

ROYAL ELECTRIC CORPORATION
301 Saratoga Avenue
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ROYAL ELECTRIC ...an associate of

ANNOUNCING...FOUR NEW G-E CERAMIC TUBES!

7266

High-Frequency diode for detector or mixer. Instrument applications include compact, low-capacitance probes.

7296

High-mu triode for oscillator, mixer, or amplifier service at VHF and low UHF frequencies.

7462

High-mu triode for amplifier service in printboard circuits, from low frequencies into UHF range.

7486

Triode specially controlled for oscillator and radio-frequency power amplifier service in UHF range.

On Display at Booths 2113 and 2114, WESCON Show!

These newly registered types, shown actual size, increase to five the number of ceramic receiving tubes introduced by General Electric. Type 7077 was the first—a world-record holder, having sent data to earth from Pioneer IV sun satellite across 407,000 miles of space.

Still more G-E ceramic types are in development. Like the five now registered, all will be high-performance tubes, small, compact. All will have extraordinary resistance to shock, vibration, and high-temperature and radiation environments.

Bring us your requirements for performance, environment, size! Contact any General Electric office below for information on ceramic tube applications in missile and space systems, ground and airborne guidance circuits, and advanced communications and navigation systems!

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(N.Y.C.) WIsconsin 7-4065, 6, 7, 8

3800 North Milwaukee Ave.
Chicago 41, Illinois
Phone: SPring 7-1600

11840 West Olympic Boulevard
Los Angeles 64, California
Phones: GRanite 9-7765; BRadshaw 2-8566

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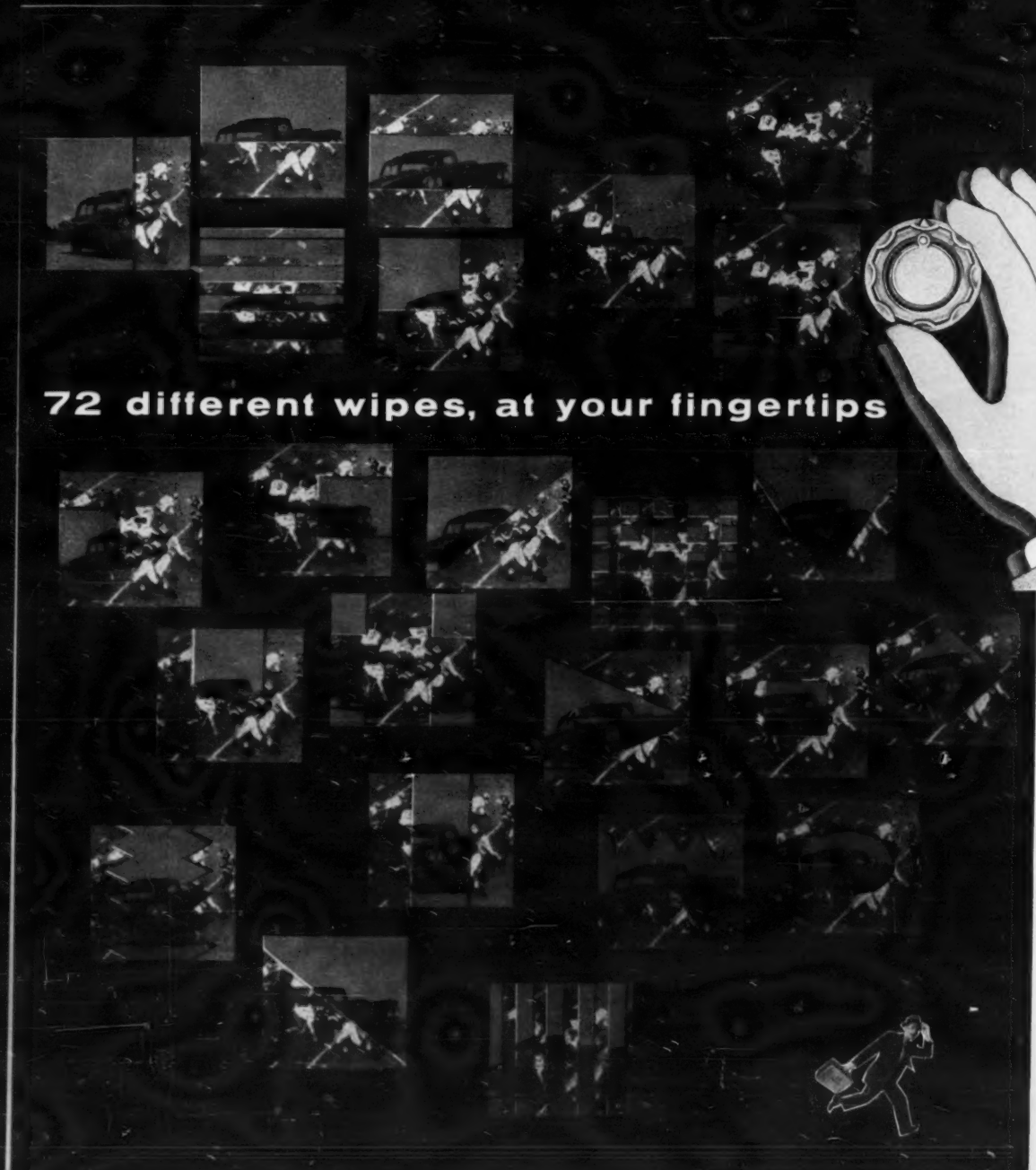
CIRCLE NO. 31 READER SERVICE CARD→



Telechrome brings to TV broadcasters a vastly improved system for producing a wide variety of dramatic wipes, inserts, keying and other special effects. The superb engineering of the Telechrome Special Effects System provides outstanding reliability and technical performance when used for either color or monochrome TV. Simplicity of pattern selection and wipe speed is provided by manual switches on the remote control unit.

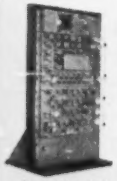
- Unusual compactness and portability make possible the creation of special effects even in field locations.
- Simplest to operate. All 72 wipes available at all times.
- Stabilized black balance between pictures. Millimicrosecond transition time eliminates edge effects.
- Additional camera input allows keying from camera signal.
- Its versatility permits use in live, video-tape or film programming.

TELECHROME

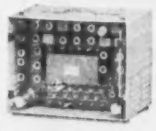
SPECIAL EFFECTS GENERATOR

FOR WIPES & MATTING, MODEL 490A

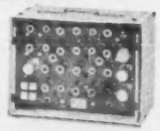
Insert Keying with Super Stability



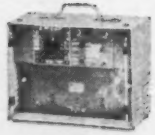
Rack Mounted



490W1 Waveform generator. Generates keying signals for the 72 different wipes.



490S1 Switching Amplifier. Combines two picture signals in accordance with applied keying waveform.



490R1 Remote Control Unit. Selects and controls desired effect. Designed for console or desk mounting. Easily modified for integration into existing studio facilities. Complete with power supply — 512CR.

Designed for 19" rack mounting, or portable cases.
Full specifications and details available on request.

AVAILABLE FOR IMMEDIATE DELIVERY.

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If you want more information on the problems faced by higher education, write to: Council for Financial Aid to Education, Inc., 6 E. 45th Street, New York 17, N. Y.

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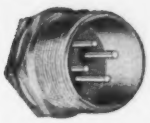
Canseals

GS



MS type. Available in many layout arrangements

HERMETICALLY SEALED CANNON PLUGS

Otto von Guericke's famous experiment with his vacuum or "Magdeburg Hemispheres" which required 16 horses to pull apart during such tests in 1650.

KH

General industrial type features Acme thread

DH

Hermetically-sealed sub-miniatures

DPSH

Designed for high altitude and vibration applications

Rugged protection and true hermetic sealing under adverse pressure and atmospheric changes.

Cannon pioneered the first successful hermetically sealed connector more than nine years ago... and since then has continually refined and expanded the line. All have special steel contacts and steel shells. Glass insulation... **fused to both contacts and shell for a permanent seal**... permits the use of **highest conductive steel contacts** compatible with any glass fusing operation. Cannon glass insulated connectors will successfully withstand continuous operating temperatures up to 500°. And for short periods of operating time they will withstand much higher temperatures.

Cannon hermetically sealed connectors are manufactured to our own commercial specifications. In general, however, voltage ratings approximate Service A of Specification MIL-C-5015C. **Salt spray, shock,** and **vibration** characteristics are all approximately within the requirements of MIL-C-5015C. Mating requirements meet MIL-C-5015C exactly. These connectors have consistently been contractually approved for military installations.

Hermetically-sealed Series available include: GS (MS type), KH, RKH, KH miniature, BFH, DH, MCH, DPAH, DPSH and DPXH.

For an interesting discussion of the broad subject of "Reliability," write for Cannon Bulletin R-1.

Write for 44-page, 2-color Plug Guide, Bulletin CPG-3

Please refer to Dept. 115

CANNON PLUGS

WHERE RELIABILITY IS THE 5TH DIMENSION

AWARENESS OF PROBLEM — INTEGRITY OF INTENT — DESIGN EFFORT — MANUFACTURING CONTROL

CANNON ELECTRIC

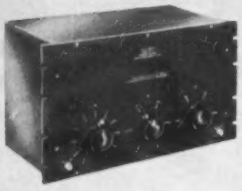
CANNON ELECTRIC CO., 3208 Humboldt Street, Los Angeles 31, California • Factories in Los Angeles, Salem, Massachusetts, Toronto, Melbourne, London. Manufacturing licensees in Paris and Tokyo. Representatives and distributors in all principal cities. See your Telephone Yellow Book.

The Proven Empire Devices Coaxial Attenuators

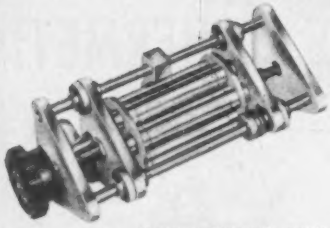
RATED UP TO 4 WATTS

AT-50: 1 W CONT., 1 KW PEAK
AT-60: 2 W CONT., 2 KW PEAK

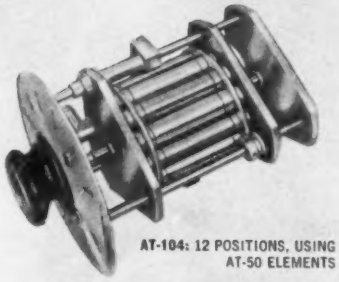
AT-75: 4 W CONT., 2 KW PEAK



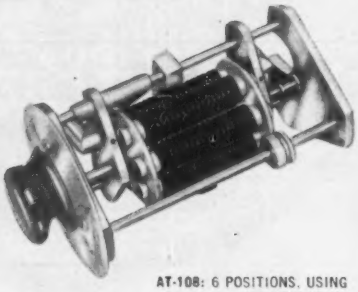
AT-106: ATTENUATOR PANEL FOR VALUES UP TO 120 DB USING COMBINATIONS OF STEP ATTENUATORS IN SERIES.



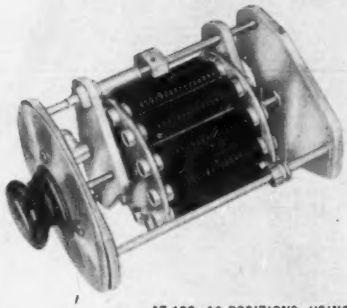
AT-103: 6 POSITIONS, USING AT-50 ELEMENTS



AT-104: 12 POSITIONS, USING AT-50 ELEMENTS



AT-108: 6 POSITIONS, USING AT-75 ELEMENTS



AT-109: 12 POSITIONS, USING AT-75 ELEMENTS

Empire attenuators have been designed and constructed for the reliable performance so essential to modern, complex systems. Their rugged construction... conservative power ratings for CW and pulse operation...and exclusive deposited carbon precision resistors... enable them to satisfy your microwave attenuation requirements.

Resistive coaxial networks furnished for frequencies up to 4000 MC, higher on special order. Low VSWR and high accuracy are inherent features. Attenuation values up to 60 DB are obtained in individual pads, rated up to 4 watts continuous and 2 KW peak (AT-75) or as six and twelve position step attenuators (AT-108, AT-109). With two or three attenuators connected in series, values up to 120 DB can be obtained.

For complete technical information, write for free catalog A-259

edp

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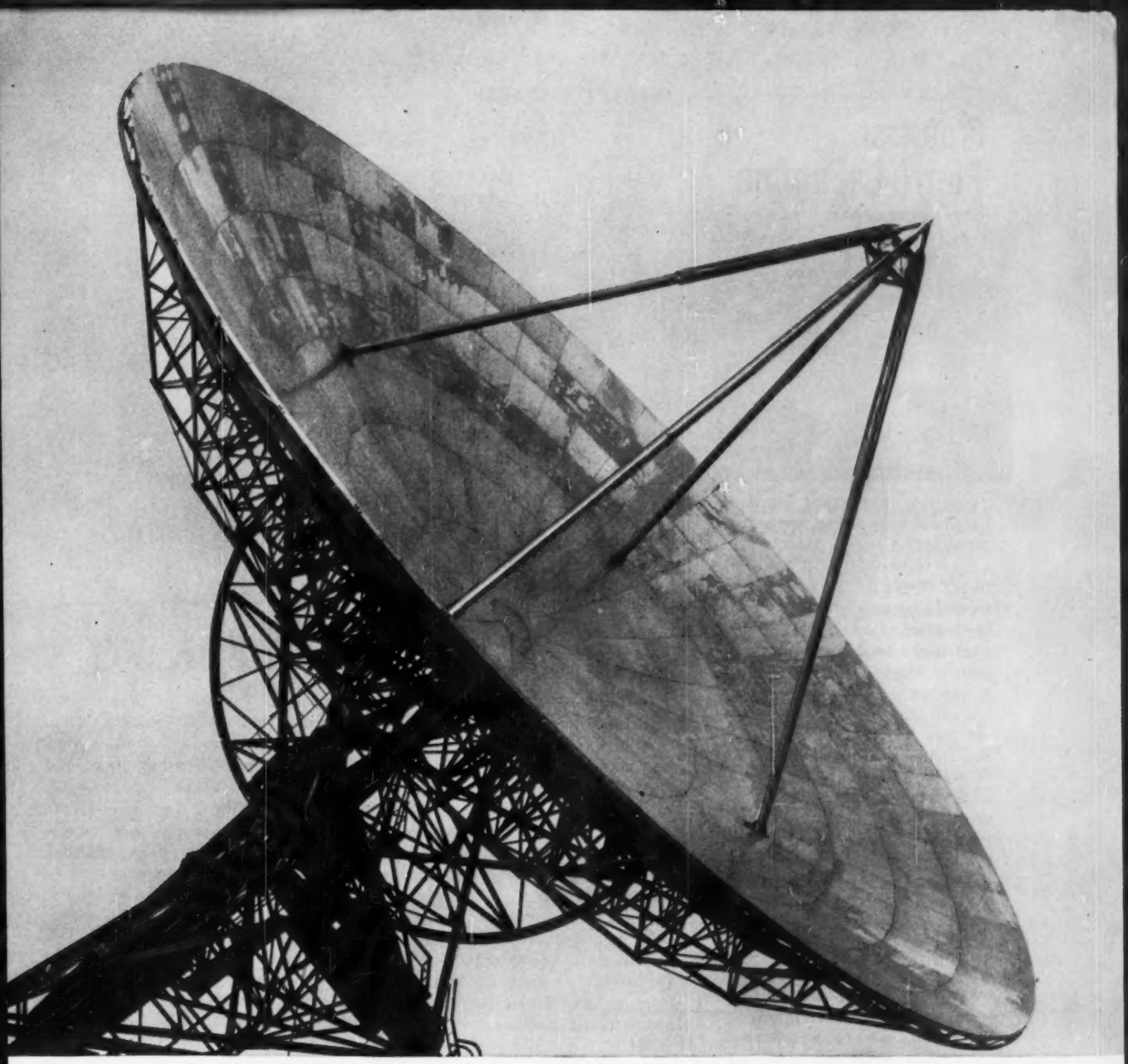


New BLAW-KNOX 85-foot diameter Radio Telescope

This new 85-foot diameter radio telescope installed atop 1,100-foot high Peach Mountain near The University of Michigan at Ann Arbor represents the latest advances in the design of large instruments for radio astronomy.

Equatorial Mount—The telescope is mounted with its polar axis parallel to the earth's axis. The reflector moves from the eastern and western horizons about the polar axis; and rotates about the declination axis from the north celestial pole, through zenith, to the southern horizon.

Determinate Design—Maximum strength-to-weight ratio is achieved through fully determinate design, in which each structural member is analyzed for stress and deflection before fabrication. The structure is designed to withstand 120 mph winds without permanent deformation.

Design, engineering and fabricating experience like this has made Blaw-Knox a world leader in the development of reliable operating equipment which embodies the most advanced scientific concepts. Blaw-Knox welcomes the opportunity to discuss projects and equipment with you.

Antennas—Rotating, Radio Telescopes, Radar, Tropospheric Scatter, and Ionospheric Scatter.

BLAW-KNOX

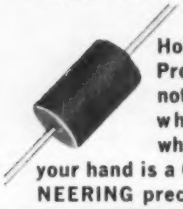
BLAW-KNOX COMPANY
Blaw-Knox Equipment Division
Pittsburgh 38, Pennsylvania

You are there – with Cinema...

Professor Pierre LaFemme

(Somewhere in the heart of Europe)

"Finally I, Professor Pierre LaFemme, have developed thees petite rocket engine capable of an amazing 200,000-pound thrust. Thees mighty mite weel be able to shoot anything to thee far reaches of outer space. But what weel I send on thees long journey. Maybe I weel even tie it to my bothairsome mothair-in-law and ignite. Ho, ho, that ees not thee bad idea for thee old bat. Bettair yet, I weel attach it to my nagging wife Fifi and watch her zoom off like thee witch she ees. But no, she weel be able to steer herself and return to earth to torment me. I have eet! I weel go myself and she weel nevair find me. Vive la Science and Bon Voyage."



Hold your horses, Professor, you're not traveling anywhere because what you have in your hand is a CINEMA ENGINEERING precision resistor. Every CINEMA quality resistor is calibrated several times, over-loaded, tested, and aged to give your equipment better than average reliability. For your critical applications demanding exacting resistance requirements, call the nearest CINEMA ENGINEERING sales representative for our catalog 14R, or write our factory direct.

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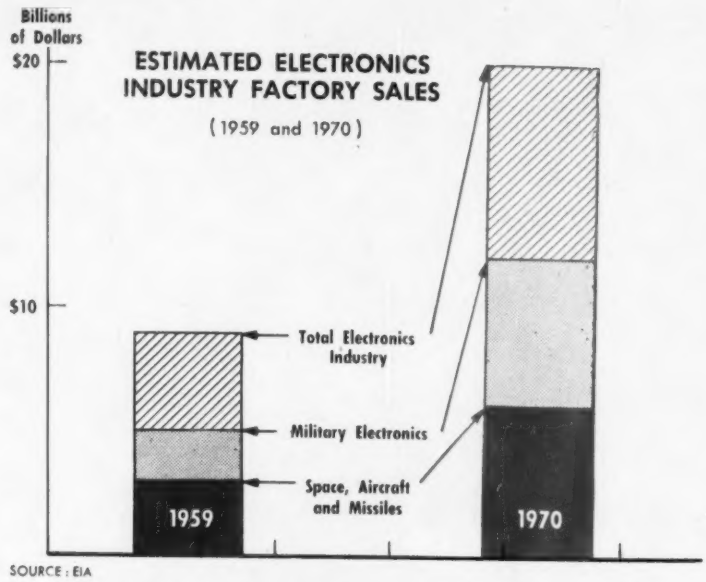
MARKET RESEARCH



SOURCE: EIA

$20 Billion Sales Due In '70

ELECTRONICS INDUSTRY factory sales in 1970 will total $20 billion, predicts Kenneth L. Baker, military specialist with Electronic Industries Association's market data department. His estimate for 1959 industry sales is slightly over $9 billion, the same amount ELECTRONICS previously forecasted for the current year.

Military electronics products sales will amount to $5 billion, or 52 percent of the $9 billion estimate for 1959, says Baker. Military portion includes $3 billion for space, aircraft and missiles.

By 1970 military electronics portion of industry sales will rise to $12 billion, or 60 percent of total industry factory sales, says EIA. Space, aircraft and missiles portion should then rise to $6 billion.

Over the next 10 years, it is expected that missiles will become the dominant defensive and offensive weapon of the nation.

At present, total missiles expenditure is at the annual rate of $3.4 billion, of which $1.5 billion goes to the electronics industry, Baker says. Total expenditure for missiles is expected to approach $9 billion by 1970. Other military experts claim the electronics portion in 1970 will be even higher than it is now.

Although space, aircraft and missiles dominate the above estimates, they will increase at a slower rate than communications, logistics, personnel-handling and other support areas. For instance, while spending for space, aircraft and missiles is expected to double over the period, spending for other military electronics is expected to treble, from $2 billion to $6 billion.

Military spending for replacement of electronic components and equipment will climb from $850 million in 1959 to nearly $2 billion in 1970, the EIA economist says. Money spent on research and development of electronic products will rise from the 1959 figure of something under half a billion dollars in 1959 to $2.8 billion in 1970. These figures have not been separately charted because they are spread throughout all categories of military expenditures.

FIGURES OF THE WEEK

LATEST WEEKLY PRODUCTION FIGURES

(Source: EIA)	July 17, 1959	June 19, 1959	Change From One Year Ago
Television sets	83,907	121,369	+49.5%
Radio sets, total	198,703	310,859	+22.8%
Auto sets	59,425	138,427	+19.4%

STOCK PRICE AVERAGES

(Standard & Poor's)	July 22, 1959	June 24, 1959	Change From One Year Ago
Electronics mfrs.	100.77	95.63	+83.5%
Radio & tv mfrs.	118.20	108.39	+134.4%
Broadcasters	102.24	101.15	+64.0%

Phone Southern California (collect)

about your future at Hughes in Fullerton

CALL MAdison 9-5211, Los Angeles
Ask for Mr. B. P. Ramstack

Are you a qualified electronics engineer—E.E. degree, 5 years of experience...interested in truly stimulating work...with an eye for solid opportunity and personal and professional growth?

Phone collect to Hughes in Fullerton, California!

Hughes in Fullerton—fastest-growing activity of the Hughes Aircraft Company—needs additional engineering talent...men to work on a variety of projects in the areas listed in the box.

Phone—any business day, up to 6:00 p.m. Pacific Daylight Time—and an authorized Hughes engineer will evaluate your qualifications on the phone and advise you of specific opportunities. Your call, of course, is in confidence—as is any subsequent correspondence.

Opportunity at Hughes is great. Environment—the place and the people—are pleasant and stimulating. Offices are private or semi-private. Average age of our engineering staff is 31 years; one out of five has an advanced degree.

Phone now—collect—or write Mr. B. P. Ramstack, at address below.

HUGHES—FULLERTON RESEARCH AND DEVELOPMENT PROJECTS

Electronic Scanning Radars—to develop new advanced applications for 3-dimensional radar.

Data Processing Systems—to design computers which monitor activity of hundreds of aircraft, and direct the assignment of defense weapons.

Electronic Display Systems—to design consoles for presentation of tactical data in symbolic or language form.

HUGHES

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Fullerton—Research and Development
Personnel Selection and Placement
Hughes Aircraft Company
Fullerton 17, Orange County, California

Who Discovers the Discoverers?

"A professor can never better distinguish himself in his work than by encouraging a clever pupil, for the true discoverers are among them, as comets amongst the stars." CARL LINNAEUS

Somewhere in this mighty land of ours, a gifted youth is learning to see the light of tomorrow. Somewhere, in a college classroom or laboratory, a dedicated teacher is gently leading genius toward goals of lofty attainment. Somewhere the mind of a future discoverer—in science, engineering, government, or the arts—is being trained to transcend the commonplace.

Our nation has been richly rewarded by the quality of thought nurtured in our colleges and universities. The caliber of learning generated there has been responsible in no small part for our American way of life. To our college teachers, the selfless men and women who inspire our priceless human resources, we owe more than we will ever be able to repay.

Yet how are we actually treating these dedicated people? Today low salaries are not only driving gifted teachers into other fields, but are steadily reducing the number of qualified people who choose college teaching as a career. At the same time, classrooms are beginning to get overcrowded. In the face of this, college applications are expected to double by 1967.

This is a severe threat to our system of education, to our way of life, even to our very existence as a nation. Our colleges need help—and they need it now!

HIGHER EDUCATION
KEEP IT BRIGHT

If you want to know more about what the college crisis means to you, and what you can do to help, write for a free booklet to: HIGHER EDUCATION, Box 36, Times Square Station, New York 36, New York.

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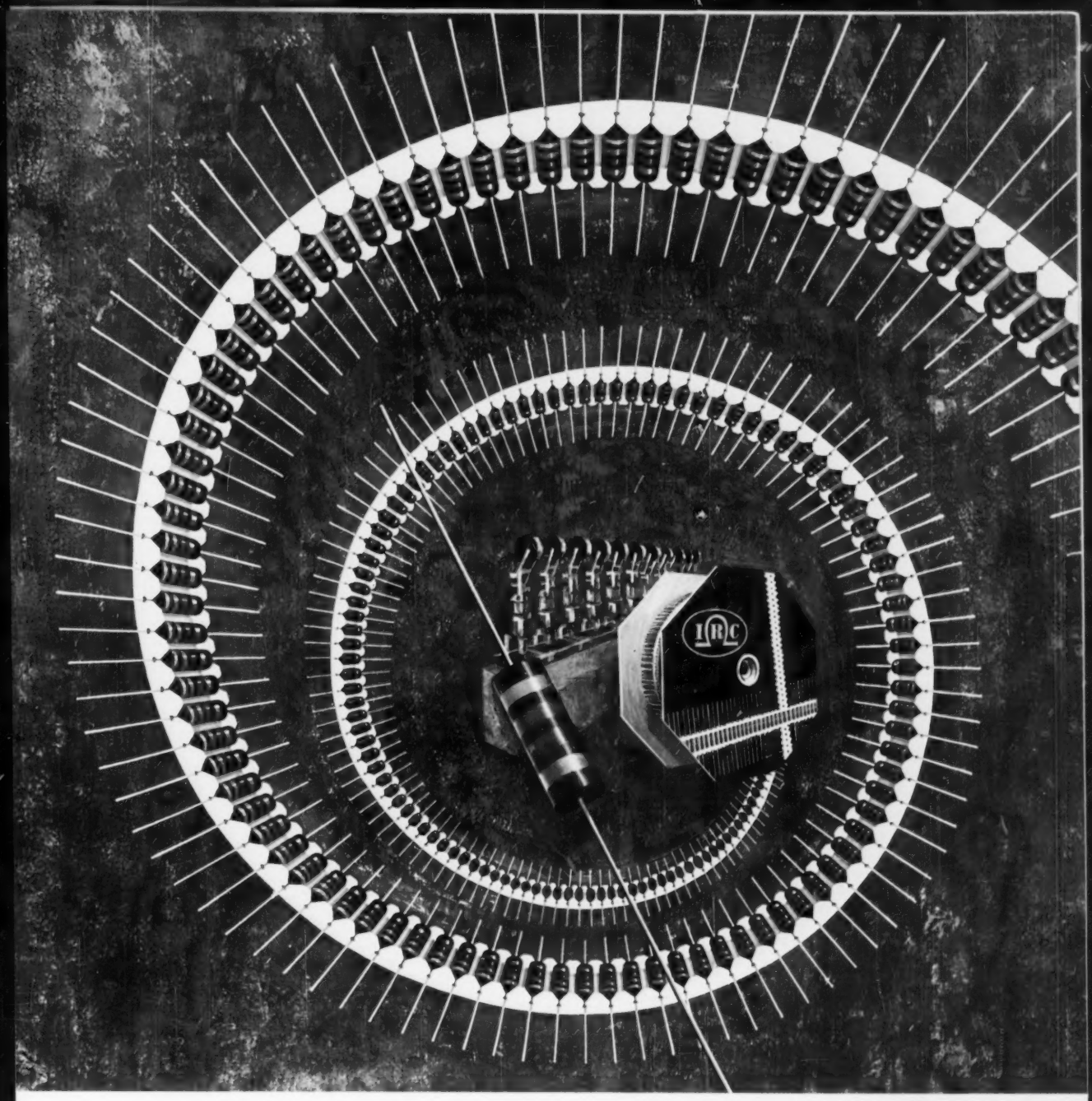
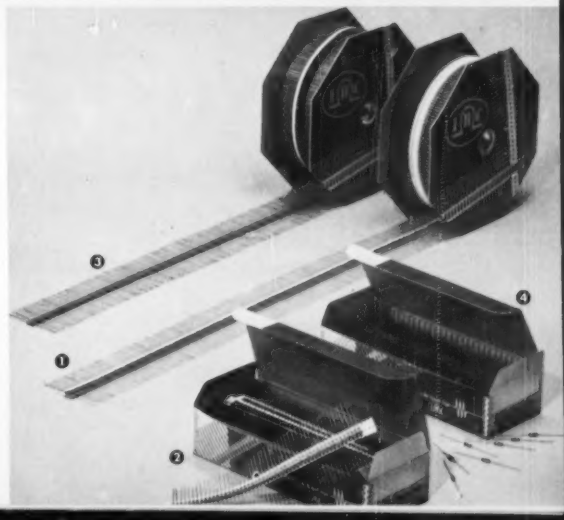


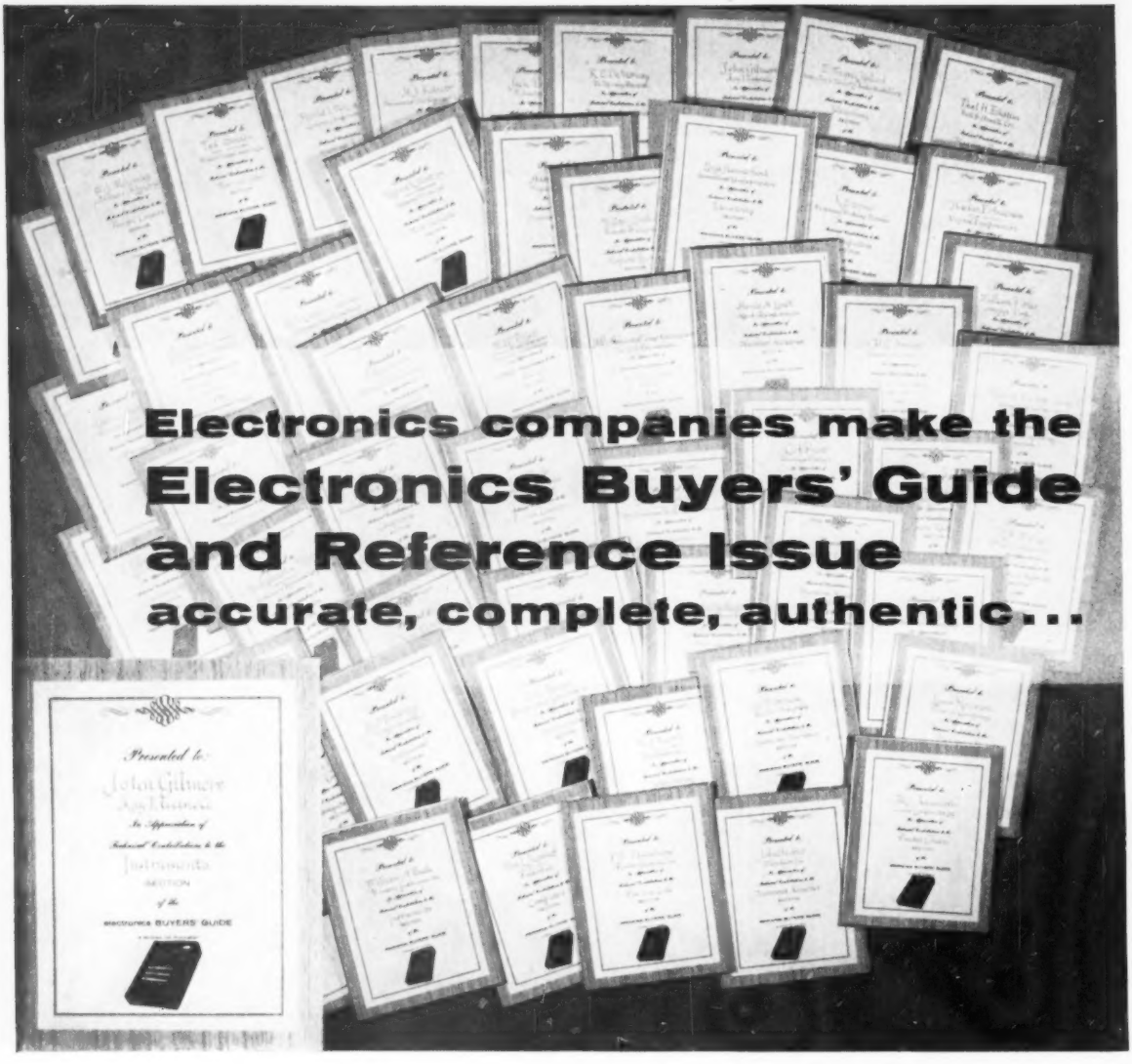
Primed for the Push Button

If there's one thing IRC resistors go along with willingly, it's Automation. Handsome new GBT resistors were designed to be automated, deliberately shaped and sized for automation. And, they're wax-free, packaged 4 different ways especially for a variety of push button machines.

1. NEW GRIP REEL—Resistors held without adhesive. Exclusively IRC. **2.** NEW GRIP STRIP—Same principle as Grip Reel but with resistors in strips of 50. **3.** BODY-TAPED REEL—Resistors on a pressure-sensitive tape. **4.** AUTOMATION PACK—Bulk resistors with straight leads, neatly oriented.
And soon to come . . . Lead Tape.



INTERNATIONAL RESISTANCE CO., Dept. 742, 401 N. Broad St., Philadelphia 8, Pa.

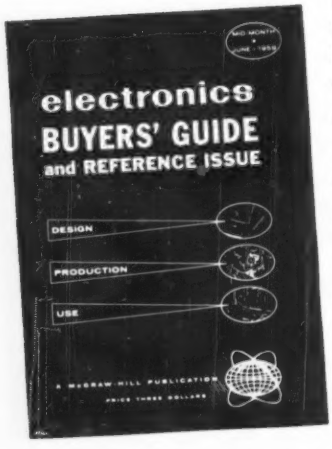


For nineteen years, firms in the electronics industry have made direct contributions to the accuracy, completeness and authenticity of the BUYERS' GUIDE.

Recently, the staff of the BUYERS' GUIDE decided to award plaques to express appreciation to those in the industry who had made direct contributions to improve the product listings. The photograph above represents a few of the awards that have been made.

The awarding of the plaques is but one indication of how the BUYERS' GUIDE evolved over the years . . . a *cooperative effort between the publication and the industry it serves.*

Only through years of experience can a buyers' guide reflect the needs of an industry as complex and dynamic as electronics . . . one more reason why the BUYERS' GUIDE is the ONE accepted product and data book in the field.



Published mid-year as the 53rd issue of electronics

A McGRAW-HILL PUBLICATION
330 WEST 42ND STREET, NEW YORK 36, N.Y.

"THE NATIVE-HOLLANDER WEARS WOODEN SHOES."

A Bell Telephone Laboratories experiment in noise appraisal

"The native Hollander wears wooden shoes."

"Nebraska has no seacoast."

"The daisy is a common wildflower."

As these syllables, words and sentences come in over the telephones, stand-ins for millions of Bell System subscribers rate them for clarity of reception.

From these tests, Bell Telephone Laboratories engineers determine what is objectionable noise, and work to minimize it in telephone circuits. They begin by tape recording background noise associated with working telephone circuits. Test statements of appropriate length and content (such as those above) are read onto a second tape, and both are fed onto the test circuit under carefully controlled conditions. A third tape, of normal room noise, is played through a loudspeaker in the test lab.

Several hundred listeners, meeting in small groups several times a day for weeks at a time, are then asked to rate the effect of noise on transmission of the various simulated telephone calls.

For the Bell System, the results of the study will become part of the over-all transmission objectives. At Bell Laboratories, they will influence apparatus and systems development work.

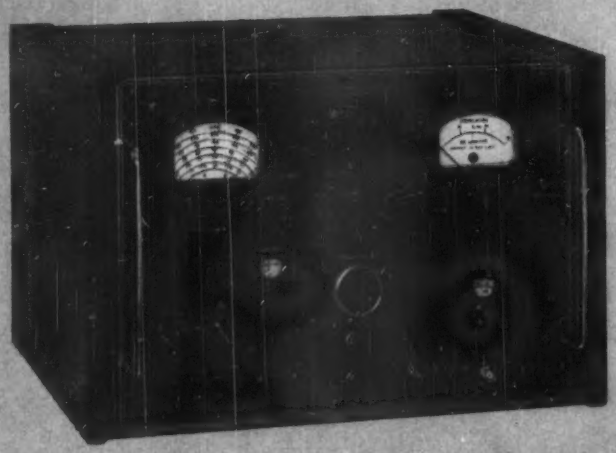
Noise is a major distraction of modern day living. It is also an enemy of the Bell System. In a telephone receiver during a call, it might be power line hum, switching or thermal noise, or perhaps atmospheric static. Bell Laboratories spends a great deal of time, effort and money to keep this extraneous noise from becoming annoying and to assure you of a trouble-free connection.

BELL TELEPHONE LABORATORIES

World center of communications research and development

New design features make this the ideal general purpose Signal Generator

BRC TYPE 225-A provides these unique advantages:



- RF settability better than ±0.05%
- RF stability 0.001% for 5 minutes, 0.001% for 5 volt line change
- Extremely low incidental FM 0.001% at 30% AM
- FM modulation from external oscillator

SPECIFICATIONS

RF Range:
10 to 500 mc

RF Accuracy:
±0.5% (after two hour warmup)

RF Output:
RANGE:
0.1 μv to 0.1 volts (across external 50 ohm load)
ACCURACY:
±10% 0.1 to 50 K μv, 10 to 250 mc
±15% 0.1 to 50 K μv, 250 to 500 mc
±20% 0.05 to 0.1 v, 10 to 500 mc

AM Range:
0 to 30%

AM Accuracy:
±10% at 30% AM, 10 to 250 mc
±15% at 30% AM, 250 to 500 mc

AM Distortion:
5% 10 to 250 mc
7% 250 to 500 mc

Incidental FM:
0.001% or 1000 cps, whichever is greater, at 30% AM

FM Range:
0 to between 5 kc and 60 kc deviation, depending upon frequency, in the range 130 to 500 mc (from external oscillator)

Pulse Modulation:
From external source

Pulse Rise Time:
<5 μsec 10 to 40 mc
<3 μsec 40 to 80 mc
<2 μsec 80 to 500 mc

Pulse Overshoot:
<10% 10 to 100 mc
<25% 100 to 500 mc

Modulating Oscillator:
400 and 1000 cps ±10%

NEW CATALOG AVAILABLE

Includes several new precision test instruments with exclusive BRC design features.

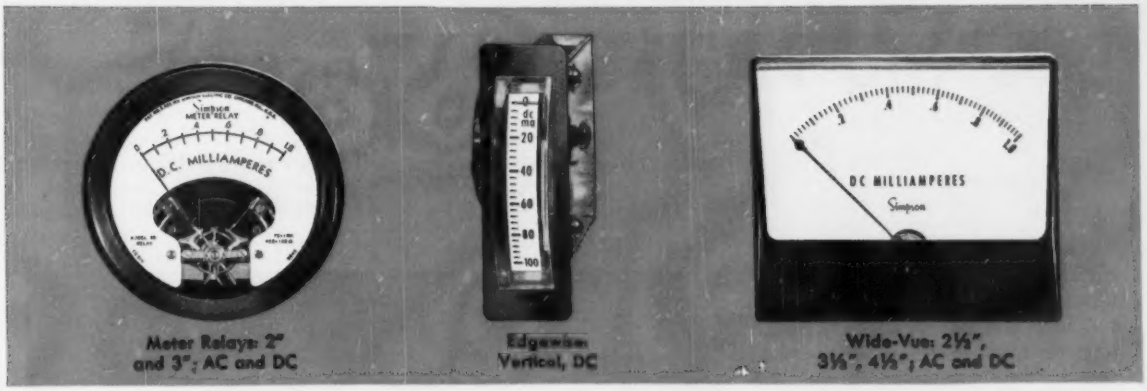
This new BRC signal generator is an outgrowth of a quarter century of experience in the design of precision electronic instruments. Ruggedly constructed for stability, reliability, and extremely low leakage, this instrument incorporates a backlash-free gear drive and a precision machined piston attenuator. Complete shielding is provided in the MOPA circuit by mounting the oscillator and amplifier in separate aluminum castings. By simply removing cabinet end bells, it is suitable for 19" rack mounting; an important feature for system applications. Because of its unique FM modulation above 130 mc, it also provides for testing and calibrating FM communication systems in the 160 and 450 mc bands. Price: $945. F.O.B. Boonton, N. J.

25th ANNIVERSARY *Precision Electronic Instruments since 1934*

BOONTON RADIO CORPORATION

BOONTON, NEW JERSEY, U.S.A.

VISIT BOOTHS 1823-1825 WESCON Show!

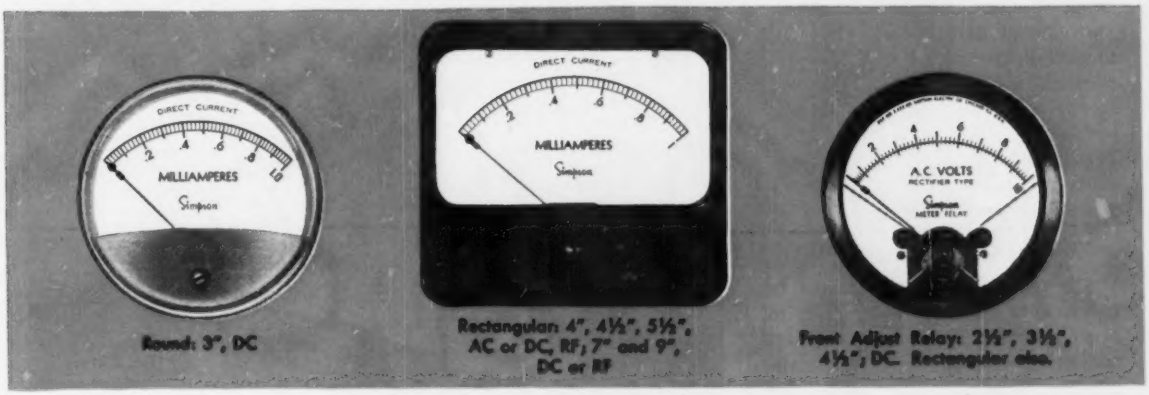


Meter Relays: 2" and 3"; AC and DC

Edgewise: Vertical, DC

Wide-Vue: 2½", 3½", 4½"; AC and DC

These are *Simpson* panel instruments...



Round: 3", DC

Rectangular: 4", 4½", 5½", AC or DC, RF; 7" and 9", DC or RF

Front Adjust Relay: 2½", 3½", 4½"; DC. Rectangular also.

engineered and built to stay accurate...

Elapsed Time: 3½"; 60-cycle AC

Fan Shape: 4½", AC or DC

Modernistic: 2½", 3½", 4½", 5½"; AC, DC, RF

available from stock or custom-built

METERS FOR EVERY NEED

Simpson

ELECTRIC COMPANY

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CIRCLE NO. 43 READER SERVICE CARD 43

Looking Ahead to Wescon

This month's technical sessions in San Francisco will sport a new look. There'll be special exhibits and 960 booths, a 27 percent increase

SAN FRANCISCO—You may not be giving a paper at Wescon in a few days but you're still expected to participate in technical discussions. The "new look" in technical sessions calls for a maximum of three papers to be delivered during each of the 42 sessions and an hour-long audience participation period in which a panel of experts leads the discussion.

Aimed at dispelling the apathy to which technical meetings are sometimes prone, the new format, in the words of convention director Albert J. Morris, is designed "to appeal to the highest order of professionalism in an effort to upgrade our presentations."

Papers Available

All papers will be available to registrants for review prior to presentation. Technical program committee chairman Karl R. Spangenberg reports that authorship this year is unusually high in professional circles. His committee points out a few papers which should have particularly broad appeal:

Ultrasonics session: A new directive sound source for long-range sonar. Described is a new type of underwater, low-frequency sound source analogous to the highly directional end fire antenna array. A recently tested 10 kc per second model showed a directivity index of over 20 db, an efficiency of better than 60 percent, and a power handling capacity of over 2 kw. Power-to-weight ratio exceeded 30 watts per lb.

Radio wave propagation session: Radio propagation measurements in the 100 to 118 kmc spectrum. Measurements recently taken over a 2,155-foot path are discussed. Attenuation due to atmospheric gases was determined and the contribution from water vapor, oxygen, and some rare atmospheric gases analyzed.

Military electronics I: An application of digital computation to a problem of Army tactics. Means by which a plan of fire for divisional artillery is derived by a computer is explained. Problems of Army combat tactics are dynamic ones, involving the interrelationship of many continually changing factors. Some lend themselves well to computer solution.

Cow Palace provides showplace for this month's Western Electronics Show and Convention

Aeronautical and navigational electronics: Analysis of a new glide-slope system for landing fixed-wing aircraft. Approach and landing requirements of many new types of aircraft preclude the use of current uhf glide-slope systems. New system requirements and operational considerations are discussed. A dual-elevation-angle technique to solve current problems is proposed.

Automatic control session: Fundamentals of a nongyroscopic inertial reference and guidance system. The possibilities of imple-

menting an inertial guidance system without the use of gyros are explored. Servo-controlled nonrotating inertia systems do not encounter problems due to bearings, heat flow, and elasticity which plague fast-spinning gyros. A system analysis is presented which indicates the superiority of inertia devices over high precision gyros.

See Lively Discussions

A technical program committee survey indicates that lively discussions should ensue at sessions on stereophonic broadcasting, medical electronics, microcircuitry, and microwave theory and techniques. Medical electronics is scheduled as an evening meeting so that San Francisco area doctors can be present and give views of the equipment users.

New sessions this year include "Human Factors in Engineering," which will involve a four-man panel without formal papers, and "The International Geophysical Year in Retrospect," at which Lloyd Berkner, president of Associated Universities, which operates Brookhaven National Laboratories, will be the speaker.

Unique Exhibits

Two special exhibits top the "must visit" list at the Cow Palace—the Future Engineers Show where the creations of 35 secondary school youths will be displayed, and the Industrial Design Exhibition. In conjunction with the latter, 140 products from 82 companies across the nation vied for the "Wescon Award of Excellence for Industrial Design." The ten items which received this award last month and 20 'runners-up' will be on display.

Purpose of this Wescon '59 innovation, according to committee chairman Harold W. Lindsay, is to "focus attention on the industrial design profession while clarifying the designer's role as a member of the electronic product development team."

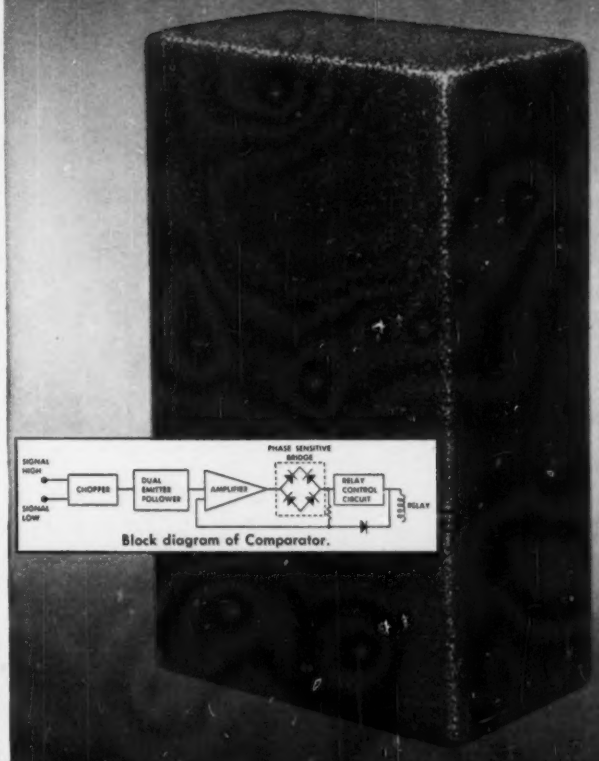
Used for the first time this year will be a "path of light" scheme, utilizing illuminated directional signs to control traffic over the 300,000 sq ft of display space. Number of booths is 960—up 27

(Continued on p 51)

Excellent career opportunities. Send resume to The Chief Engineer

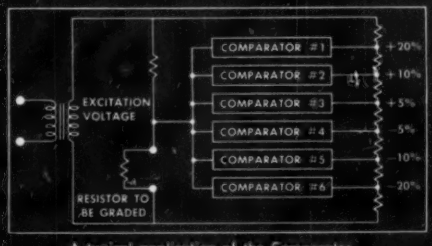
for "GO-NO GO" automatic monitoring/control... new trio labs'

ALL-TRANSISTOR VOLTAGE COMPARATOR



ACTUAL SIZE

Block diagram of Comparator.



A typical application of the Comparator in an automatic resistor grading system.

SPECIFICATIONS

AC Sensitivity: 5 MV
DC Sensitivity: 10 MV
Input Impedance: 2 Megohms (min.)
Output: DPDT relay, contact rating 2 Amps. at 28 V DC
Power Requirements: 115V, 400 cycles, 1 watt
Repeatability of Trip Point: ± 1 MV
Performance will meet or exceed appropriate MIL specifications.
AC or AC DC versions available.

Series 200 trips its own DPDT output relay when an unknown input signal exceeds the value of a known input reference level. This direct voltage comparison is the most reliable technique for automatic, programmed accurate measurement with computer-speed. Applications, virtually unlimited, include: military ground support devices, airborne instrumentation, production test equipment, alarm/control systems, and many data-gathering and processing systems. Write for reprint of article in "Military Systems Design" magazine. Also for Tech Bulletin. Address Dept. E-8

Trio Laboratories, Inc., Plainview, Long Island, New York.

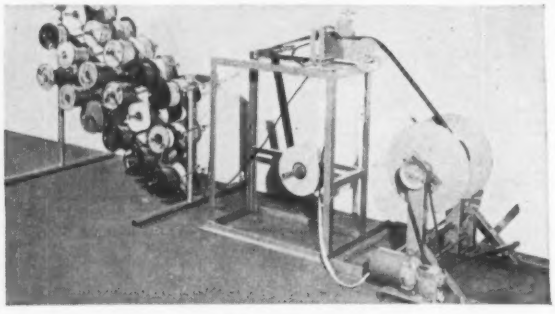
trio

WESCON BOOTH 3728

NEW Automatic Electronic CABLE-making Machine To Be Shown at WESCON!

(Los Angeles, California) After years of development, The Zippertubing Company announces production of a machine which automatically makes cables at speeds up to 900 feet per hour. This machine, occupying only 24 square feet of floor space, produces cables with up to 108 conductors and is so simple to operate that inexperienced personnel can make cables to any specification.

This new equipment utilizes the revolutionary Zippertubing cable jacketing, which is fed into the machine along with the required number of conductors. The Zippertubing then is automatically wrapped around the conductors, zipped closed and, if required, permanently fused with a chemical sealer. The completed cable automatically is wound on the take-up reel for storage or shipping. The machine will produce cable from ⅜" to 2½" O.D. with larger sizes on special order.



Complete unit with wire reels in place.

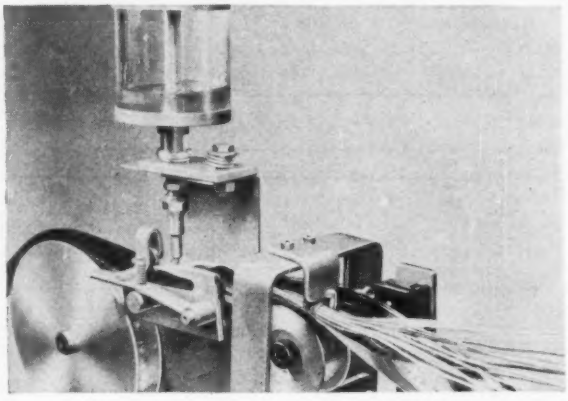
MULTI-JACKETED CABLES IN ONE STEP

By using Zippertubing laminated materials, cables which require jackets of several different materials can be made in one step without costly re-handling. Available jackets include copper, aluminum or Co-netic steel in combination with such materials as vinyl, Mylar,* or fiber glass. Other laminates for high temperature exposure, abrasion protection, etc., also may be used in the machine.

SUBSTANTIAL SAVINGS

Up to 90% of the labor costs formerly involved in fabricating cables are eliminated through the use of the Zippertubing Cable Machine. Only limited floor space is necessary for long-run continuous lengths, and material waste, skilled labor investment and expensive extruding equipment no longer are required. Expensive "minimum" orders for custom extruded cabling as well as delay in deliveries also are eliminated. Because of the flexibility of Zippertubing, small cable runs for R & D work are economically feasible. Zippertubing cables can be re-opened for additional work on conductors, virtually eliminating the great costs formerly incurred in correcting mistakes in prototype development.

**Trademark of duPont.*



Close-up of head showing Zippertubing jacketing and conductors being formed into cable and automatically sealed.

MEET MIL SPECS

Cables produced on this new equipment meet all necessary MIL specs, depending on the jacketing material and the purpose for which it is to be used.

CABLE MACHINE FREE

One of the purposes of this new machine is to help manufacturers reduce their capital investment and inventory in electronic cables. A special plan has been developed whereby manufacturers who use 10,000 feet or more of Zippertubing jacketing per month will be provided with one of these machines at no cost. For those with more modest requirements, the machine may be leased very inexpensively with option to buy, or it may be purchased outright. A 100% lifetime guarantee is available under all plans. When ordering, allow three weeks for delivery.

AVAILABLE IN THREE PARTS

The Zippertubing cable machine may be ordered in three units: basic unit, which includes the head and sealing device; wire payoff unit, which contains the "tree" and spindles for holding the wire reels; power unit, which has the take-up reel spindle, frame and 115 V AC/DC motor that pulls the cable through the complete process.

SEE MACHINE IN OPERATION AT BOOTHS 1104 & 1201

For complete catalog information or field engineering service, write to the manufacturer: The Zippertubing Company, 752 So. San Pedro St., Los Angeles 14, California. TWX LA 840. Sales offices and warehouses are located in all principal cities.

(advertisement)

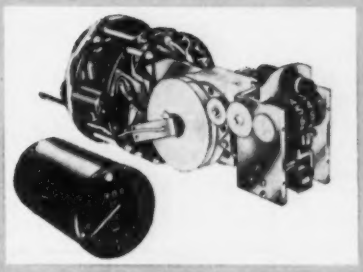
CIRCLE NO. 47 READER SERVICE CARD→

A HOFFMAN SEMICONDUCTOR APPLICATION CASE HISTORY

THIS VOLTAGE STABILITY PROBLEM HAD TO BE SOLVED

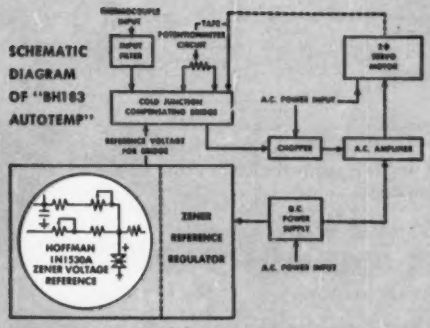
VISIT BOOTHS
Nos. 2222, 2223, 2224, 2225
at the WESCON SHOW

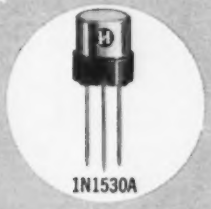
FOR CIRCUIT RELIABILITY IN A JET ENGINE TEMPERATURE INDICATOR



Hoffman Zener Voltage Reference Elements were the solution

SCHEMATIC DIAGRAM OF "BH183 AUTOTEMP"





Engineers of the B & H Instrument Company, Fort Worth, Texas, required an extremely reliable voltage reference device for their BH183 AutoTemp jet engine temperature indicator, used in the Lockheed Electra. . . . They chose a Hoffman 1N1530A Zener Reference Element, because of its STABLE characteristics even when subjected to widely varying environmental conditions.

The low 8.4 volt, zener operating voltage of Hoffman 1N430 and 1N1530 Zener Reference Elements, makes them uniquely suited for use in circuits which are operating at a low D.C. voltage level (from 10 to 30 volts). The units have a voltage stability of ±0.1%, or less, over a temperature range from −55°C to +100°C, at 10mA.

There are over 180 Hoffman Zener Devices available . . . now in the widest possible range of voltage and power dissipation ratings. Write us . . . tell us your problem . . . the Hoffman semiconductor sales engineer in your area will provide the solutions.

If you need a job in electronics done quicker and better, contact

Hoffman Electronics
CORPORATION
SEMICONDUCTOR DIVISION
930 PITNER AVENUE EVANSTON, ILLINOIS

KAY...

The Most Complete Line of High Frequency Attenuators

NEW KAY *DRD Attenuators*

(ROTARY SWITCHABLE)

Provides Digital Readout of Attenuation 1-119 db

Standard Toggle Switch Models, 1-101 db

- **Fixed Zero or 10 db Insertion Loss**
- **Choice of 50, 70, or 90 Ohm Impedance**
- **Improved Accuracy — Reduced Maximum Error**
- **High Frequency Switches—Solid Silver Contacts Set in Teflon**
- **1% Carbon Film Resistors**

The three models of Kay *DRD Attenuators* listed at the right hand side of the table offer the convenience of a direct-reading dial. Attenuation can be varied from 1 db to 119 db in one-db steps by operating two rotary switches. The standard Kay *Attenuators* operated by six or nine toggle switches are listed at the left. All models are set in lightweight cast bronze housings and offer reduced maximum total error and a negligible insertion loss.

	STANDARD TOGGLE SWITCH MODELS						DRD MODELS	
	MODEL	CAT. NO.	MODEL	CAT. NO.	MODEL	CAT. NO.	MODEL	CAT. NO.
	20*	430-B	20-0*	431-B	30-0*	432-C	40-0*	433-A
	21†	440-B	21-0†	441-B	31-0†	442-C	41-0†	443-A
	22‡	450-B	22-0‡	451-B	32-0‡	452-C	42-0‡	453-A
Z_{in} Z_{out}	*50 ohms nom.		†70 ohms nom.				‡90 ohms nom.	
DB Switched	41 db in 6 steps				101 db in 9 steps		119 db total in 1-db steps	
Steps	20 db, 10 db, 5 db, 3 db, 2 db, 1 db				Same as 41-db units, plus 3 extra 20-db steps		1 db and 10 db	
INSERTION LOSS	10 db		Zero db at low frequencies; approx. 0.1 db at 250 mc; approx. 0.2 db at 500 mc					
Maximum Total Error (includes insertion loss)	At full attenuation: 0.5 db at 250 mc; 1.2 db from 250 to 500 mc				At full attenuation: 1.0 db at 250 mc; 2.0 db from 250 to 500 mc			
	BETTER ACCURACY AT LOWER FREQUENCIES AND/OR USING FEWER ATTENUATION STEPS							
Frequency Range	DC to 500 mc; useful to 1000 mc							
SWR	1.2:1 max. up to 250 mc; 1.4:1 max., 250 to 500 mc							
Maximum Power	½ watt							
Connectors	BNC type UG-185/U							
Dimensions	2" x 7" x 2"				2" x 9¾" x 2"		5" dia. x 2¼"	
Weight	2 lbs.				3 lbs.		4¼ lbs.	
Prices	$70.00		$65.00		$95.00		$195.00	

All prices f.o.b. factory.

NOTE: Kay *Attenuators* can be made on special order in 0.5 db steps, and to customer's choice of insertion loss, attenuation range, and impedance rating.

SEE US AT WESCON SHOW BOOTHS 3114 & 3116

WRITE FOR KAY CATALOG 1959-A

KAY ELECTRIC COMPANY

Dept. E-8 Maple Avenue Pine Brook, New Jersey CApital 6-4000

your electronic wire and cable problems end here

Fast moving electronic technology so often demands wire and cable construction to meet specific performance needs. As a "specialist in specials" Chester's engineering and production facilities are geared to meet both military and commercial requirements for plastic insulated wire and cable, while offering standard constructions for more general applications. The few types shown on this page are typical, high-quality Chester products, all of which may be varied to solve your electronic wire and cable problems.

SEND FOR THIS FREE CATALOG

The full story of Chester wires and cables for the electronic industry is in condensed catalog ELT-1.

CHESTER CABLE CORP.

CHESTER, NEW YORK

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Visit Us at WESCON Show—Booth #2401

Distributed by GraybaR

COAXIAL CABLES

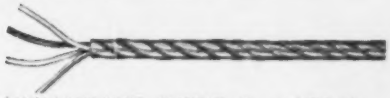
RG types in both standard and special designs; military or commercial versions. Meet all MIL specs. Miniature designs, too.

MILITARY HOOK-UP WIRES

A complete line for all military and commercial needs. Includes the new "Thrif-T-Bond"® bonded, tinned wire. Nylon, Teflon, braided jackets. Color-coded.

MULTI-CONDUCTOR CABLES

For computers and related equipment. Any number of color-coded conductors grouped to your requirements and sheathed.



MINIATURE WIRE & CABLE

Single or multi-conductor types in #18 to #30 AWG sizes with thin wall Plasticote® jacket. For radio, TV, electronic equipment.

AUDIO WIRES & CABLES

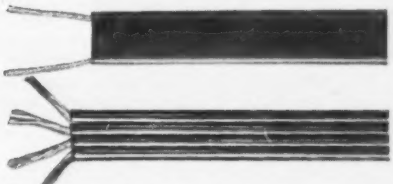
Microphone, phonograph, intercom, etc. An extensive selection of single and multi-conductor types for every audio application.

HI-V AND HI-F WIRES

High frequency test lead, high frequency lead wire and flame-retardant high voltage wire. For use on flyback transformers, accelerating anodes, etc.

APPARATUS WIRES

Wire sizes from #16 to #27 AWG, solid or stranded, Plasticote insulated. Range: —40°C to 90°C, 600 volts, AC.



TV TRANSMISSION LINES

Covering the broad field of TV, including lead-in wire, TV rotor cable, primary and secondary lead-in coaxial cables.

WE MAKE THE SYSTEMS WORK

Almost unique in the world of the electronics industry, Federal Electric Corporation serves as a complete engineering service organization for the government, for industry and for its parent organization, International Telephone and Telegraph Corporation. A central engineering department, at Paramus, provides a professional staff for systems and application engineering, layout and installation planning, equipment and systems evaluation —and publications services.

Our job is "making the systems work". After complex electronic equipment or systems are designed and built, they must be installed by experts, properly aligned, tuned and tested to assure operation at peak performance. Then they must be continuously maintained to assure dependability. In some cases teams must be provided to operate the equipment, or to train the user to operate it. All this we do — exercising complete management responsibility.

Prime examples of Federal projects are the DEW Line of radar stations across Canada and Alaska and the White Alice communication system in Alaska. In many parts of the world FEC has installed and tested TACAN and ILS systems for military and commercial use. Today Federal is also engaged in engineering operations connected with missile test ranges in Florida and California. From the Arctic Circle to Spain Federal Electric is keeping systems working.

For further information regarding positions in our Systems Engineering staff, at Paramus, and field engineering assignments in the U.S. and abroad, write W. F. Duffy, Professional Placement.

FEDERAL ELECTRIC CORPORATION

An Associate of International Telephone and Telegraph Corporation

Paramus Industrial Park, Paramus, New Jersey

What Wescon Exhibitors Are Saying . . .

Radio, tv, military systems manufacturer: "We don't expect to make any sales at the show, but we're participating for the prestige value and because our competitors will be there in force. We'll primarily be displaying capabilities rather than new products and hope to make the usual number of contacts for follow-up calls later on. There'll be a big group from our company and symptoms of last year's austerity program are practically non-existent. We'll be recruiting heavily—production people as well as R&D—since several of the items which have been in R&D during the past years are now in production and we must build up our work force. Our semiconductors booth will stress new applications of silicon diodes and Zener reference units."

Missile systems, control equipment company: "While we won't have a display this year, we expect to be quite active in recruiting areas and learning what suppliers and competitors have done over the past year. We've heard that there may be some interesting "competition" displayed between U. S. producers and European, Japanese, and possibly Russian contingents which will be present."

Diversified industrial electronics firm: "We're not introducing any new products this year and consequently are not preparing for a "hard sell" show. We're going mainly for contacts. Our emphasis will be less on military systems and heavier on industrial and commercial items. We feel that there may be a trend along this line among other formerly predominant military electronics people—less models of missiles and more industrial gear."

Components maker: "We'll be looking more for business cards and follow-up contacts than customers to sign on the dotted line. We're introducing a few new products, but in the main, are stressing upgraded and improved existing lines. The show this year will undoubtedly have the same business-like air it has had in the past. People don't go to Wescon to "blue sky" and drink. It's a vital part of the education process of all electronics people. If there is an over-riding emphasis on any one field of electronics I'd say it would be on ground systems. Also, we expect to see some concentrated effort on the part of tube manufacturers who are pushing tiny vacuum tubes in competition with transistor people."

Instrument manufacturer: "We look for another good year at Wescon but not as good as if it were held in Los Angeles. Eighty-five percent of our business from the West comes from the L. A. area, and more prospective buyers attend the L. A. show. Our emphasis will be on equipment reliability and efficiency, and how our equipment can cut customers' costs."

Looking Ahead . . .

(Continued from p 45)

percent from the last San Francisco show. To facilitate greatest coverage in a given amount of time, exhibits will be grouped by category—instruments, components, etc.

In an effort to more tightly integrate convention activities, field trips have been scheduled to tie in with IRE professional group categories, and will closely follow the related technical sessions. Seven of the Bay area's top electronics manufacturers have been chosen to host field groups, and two tours have been arranged in conjunction with Stanford University activities.

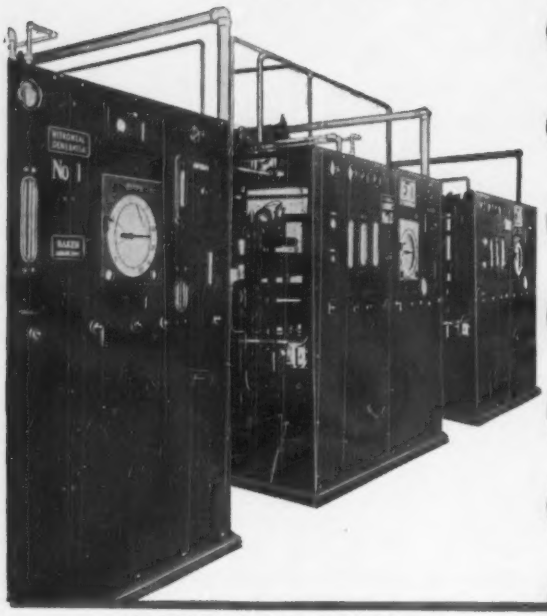
York to Speak

Featured speaker at the all-industry luncheon will be Herbert F. York of the Defense Department's research and development section. H. Leslie Hoffman will sketch a verbal picture of things to come in his WEMA luncheon talk, "Look Ahead to 1975."

Theme of the ever-popular all-industry cocktail party on opening day will be "Wescon Welcomes the 50th State." Four party rooms at the Sheraton-Palace will be replete with palm trees, and women guests will be given fresh leis by six costumed Hawaiian belles.

Five-ft model of moon, featured in central decoration scheme for 1959 Wescon, is admired by H. Myrl Stearns (left), Wescon board chairman, and Bernard M. Oliver, executive committee chairman

for the most efficient production of oxygen-free gas



NITRONEAL® GAS GENERATOR

. . . provides by far the most economical and efficient method for the production of pure nitrogen —*completely free of oxygen*—and with hydrogen content precisely controlled at any desired percentage between 0.5% and 25%. Nitrogen is supplied at a fraction of cylinder supply cost.

The Nitroneal Generator is automatic except for startup, with no need for operating personnel. The unit performs instantly, efficiently anywhere in the range of from 25% to 100% of rated capacity. Installation requires only a 110 volt line, water, air, ammonia lines and drain facilities. Units can be supplied in capacities of 100 cfh to 10,000 cfh. . . . The catalyst lasts indefinitely—maintenance costs are practically nil. Write for complete catalog material and data.

CHEMICAL DIVISION • 113 ASTOR STREET NEWARK, N. J.

CIRCLE 18 READERS SERVICE CARD

look to Amersil for all high purity fused quartz requirements.

Amersil manufactures and fabricates high purity fused quartz for ultraviolet transmission applications, laboratory ware and production equipment. These products include standard apparatus, plain tubing in many intricate fabrications, crucibles, trays, cylindrical containers and piping in a full range of sizes up to 25" in diameter. Ingots and plates are available in general commercial quality as well as in special optical grades. Amersil engineers are also prepared to assist in developing fused quartz and silica equipment for special requirements. Send for bulletin.

AMERSIL QUARTZ DIVISION • 685 RAMSEY AVENUE HILLSIDE, N. J.

CIRCLE 19 READERS SERVICE CARD

CHEMICAL DIVISION

WRITE FOR LITERATURE

AMERSIL QUARTZ DIVISION

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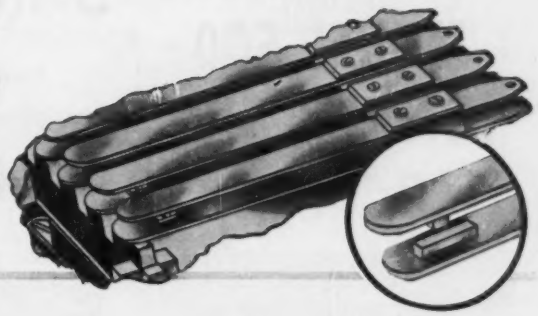
a simplified mirror-bright silver plating process

Here is the most efficient, simple procedure to protect electrical electronic and lamp components with a mirror-bright silver finish—through a complete range from flash to heavy deposit. The procedure is easy, economical and non-critical—with little or no polishing required. Silva-Brite is a clear, water-white solution, enabling the operator to observe work as it is being plated. Uniformly good results are attained with current densities ranging from 10 to 40 amperes per square foot. Normal room temperature operation minimizes fumes and tendency toward bath decomposition. Send for descriptive data together with detailed plating procedures.

AMERICAN PLATINUM & SILVER DIVISION
231 N. J. RAILROAD AVENUE, NEWARK, N. J.
CIRCLE 20 READERS SERVICE CARD



ECONOTAPE crossbar contacts are most efficient for electrical relays

You can now get ideally efficient crossbar contacts for your electrical relays—with as many contacts as you need, where you need them—with positive assurance of full, contact surface. This has been made possible through the development of Makepeace's new ECONOTAPE, a precision-drawn shaped or rectangular contact wire in either solid precious metal or in laminated metal —in your choice of gold, platinum, palladium, silver and their various alloys.

Econotape crossbar contacts are supplied complete, attached to Makepeace blades . . . attached to blades supplied by you...or Econotape for your own attaching.

Econotape is cut off and welded to the blade in one operation. It is no longer necessary to handle and attach individual button type contacts. Positioning of Econotape on the blade is done automatically as the tape is cut off and welded. Permanent attachment is assured by a homogenous metallurgical bond that is undisturbed by expansion and contraction caused by temperature changes.

If you are designing a new relay or trying to cut the cost of your present mechanism, send for Econotape Crossbar Contact literature.

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ENGELHARD INDUSTRIES, INC.
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NEW SPRAGUE MODEL 500 INTERFERENCE LOCATOR

PORTABLE, VERSATILE UNIT PINPOINTS SOURCE OF INTERFERENCE

This improved instrument is a compact, rugged and highly sensitive interference locator—*with the widest frequency range of any* standard available unit.

New improvements in Model 500 include: *greatly increased sensitivity*, meter indications proportional to carrier strength, transistorized power supply. Engineered and designed for practical, easy-to-operate field use, it is the ideal instrument for rapid pinpointing of interference sources by electric utility linemen and industrial trouble shooters. Model 500 tunes across the entire standard and FM broadcast, shortwave, and VHF-TV spectrums from 540 Kc to 216 Mc. For full details send for brochure IL-102.

SPRAGUE ELECTRIC COMPANY
35 MARSHALL ST. • NORTH ADAMS, MASS.

SPRAGUE®
THE MARK OF RELIABILITY

Sales-Order System

Here's how one company meets firm delivery promises, develops and holds new customers

By ROBERT F. STOCKTON, III and HAROLD L. WEINBERG

Manager of Sales — Manager of Manufacturing
G-V Controls, Inc., Livingston, N. J.

Production control clerk consults progress chart to report status of a customer's order. Dark tabs tell stage order is in, when last reported on

WE HAVE a two-part sales-order system that works very well. One part controls in-plant order scheduling, the other runs our sales projects.

Necessity was the mother of both. And now both are indispensable members of our business family.

First, order scheduling.

For each product category, the sales department forecasts total sales 4 to 6 months in advance. Production then sets up weekly capacity schedules based on this forecast.

It takes 4 weeks to process a normal order. So 4 weeks before delivery date, sales tells production exactly what types and quantities it is to ship. This way, calling the shots, sales can make promises to customers, order any changes wanted. But once orders go to production, no changes can be made except in emergencies—and then only if production agrees.

On a rush order (under 4 weeks) two additional steps are taken: 1. Quantities are limited to 10 production units per order. 2. The move ticket (which travels with each order) gets a priority code. Since each production station handles orders on basis of earliest date, the rush request is met.

Seven assembly line check-points keep track of all orders. Each station records work done that day. Production control gets all records the next morning.

Each order has a card that slides into the slotted vertical card-holder (photo). Only the card's top sticks out. Cards are grouped according to date due. A visual indicator on each card tells what stage the order is in.

But this isn't enough. We must know when the order was last reported. We have a different indicator color for each day of the week. Thus, we know where the order stands in production and what day it was last reported on—all at a glance. Sales can immediately answer customers' delivery questions. Production constantly knows what's lagging, where every order is in the shop.

Any prospective customer becomes a project card. Projects are grouped by areas where we have sales reps. Each project card heading describes the project in terms of our products and in terms by which the customer identifies it.

Issuance of this card to our sales

Pays Off

rep tells him we will keep an active record on the project until a sale is made or the project fizzles.

All papers—orders, memos, letters—pass across the desk of the man running the Project File. For each, he identifies the project and enters an abstract of significant data on the project card.

If nothing happens for several months, we send the sales rep an inquiry form. It gives the project's latest status, asks for new data. The form makes it simple for the rep to reply.

The visible edge of each card in the file carries 24 numbered spaces —one for each month for 2 years. Each entry on the card is marked with a symbol in the proper square on the visible edge—S means samples have been supplied, T that tests are underway, and so on.

"Move Is Ours"

Thus a quick glance tells us how long it has been since we have had word on any project. Most symbols are marked in blue. A red symbol means the next move is ours . . . the customer is waiting for test data, engineering recommendations, or other information.

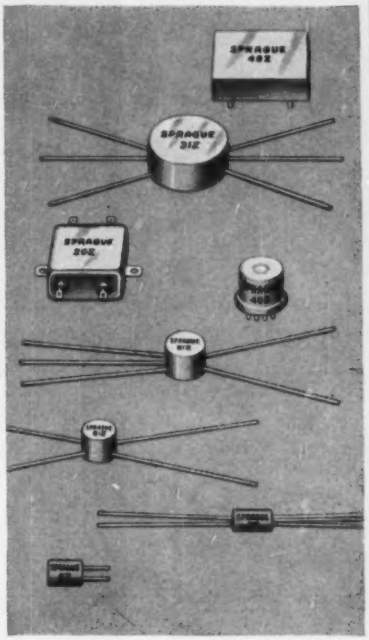
When the project no longer warrants attention, the card is moved to a dead file. When the project results in a production quantity order, the card is shifted to another file where it reminds us to go looking for another order later on.

This system makes sure we give customers continuing assistance, and that we do not lose sales by failure to follow-up.

The system has also produced much other useful information. From it we learn which sales areas do the most consistent follow-up work and which turn the highest proportion of projects to actual sales. Sales management people consult the project file before visiting a territory to see what the important projects are.

A periodic review of all projects tells us of the relative interest in our various products and how it is changing. It tells us how many of our projects result in sales, and how many we lose and why.

Miniature Pulse Transformers



Sprague miniature pulse transformers are ideally suited for application in low-power, high-speed computer circuitry where pulse signals may range up from 20 millimicroseconds and wider in duration, at repetition rates as high as 10 megacycles, with pulse levels ranging from fractions of a volt to several hundred volts.

Typical circuits utilizing Sprague Pulse Transformers include *pulse amplifiers* (for current or voltage step-up, impedance matching, decoupling, pulse inversion and push-pull operation); *pulse shaping and differentiating; blocking oscillators* (in regenerative circuits of the triggered and self-triggered type); *general transistor circuits.*

Choose from Sprague's wide variety of mounting styles, shapes and encasements . . . for conventional or printed wiring board assembly.

Write for the complete series of engineering bulletins to Technical Literature Section, Sprague Electric Company, 35 Marshall Street, North Adams, Massachusetts.

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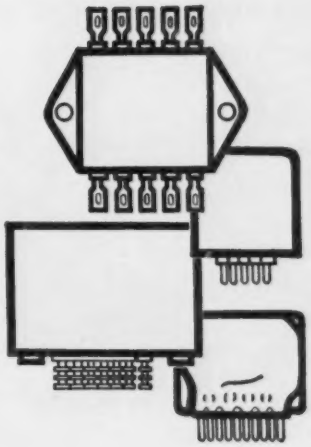


Sprague offers a wide variety of

MAGNETIC SHIFT REGISTERS

for aircraft, missiles, computers, and controls

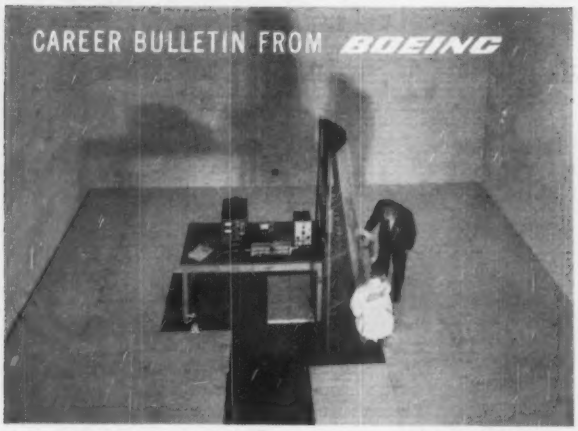
Just the right case styles . . . types of sealing . . . number of stages . . . read and write provisions you need! Sprague magnetic Shift Register Assemblies are matched to your *specific* application requirements to make them your best buy!

Standard designs are easily modified to meet most system requirements. All are 100% pulse performance-tested before they leave the plant.

For engineering assistance on your Shift Register problems, write to Special Products Division, Sprague Electric Company, Union St., North Adams, Mass.

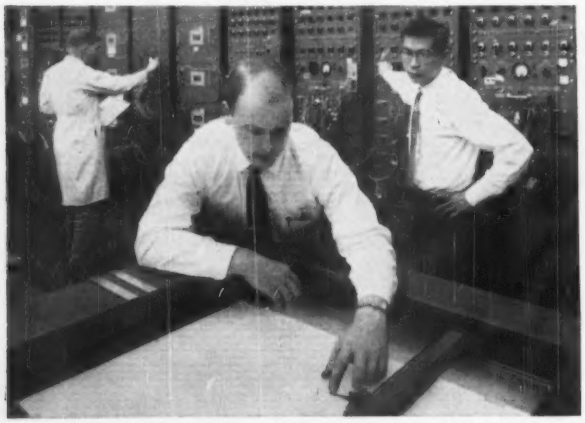
SPRAGUE®
THE MARK OF RELIABILITY

CIRCLE NO. 55 READER SERVICE CARD

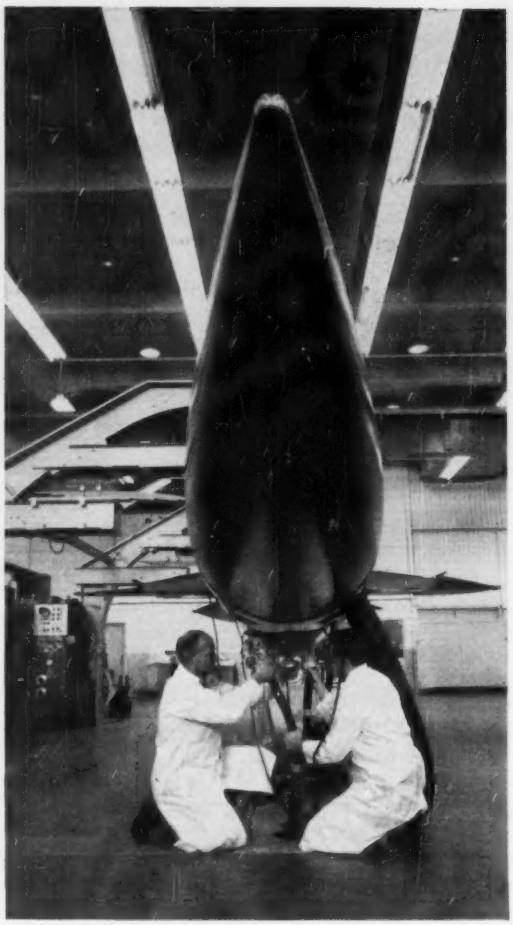


FREE-SPACE ROOM in Boeing antenna and radar laboratory, built for advanced antenna and radome development and testing. Expanding missile and advanced jet aircraft projects at Boeing provide outstanding career opportunities for engineers in virtually every area of electronics.

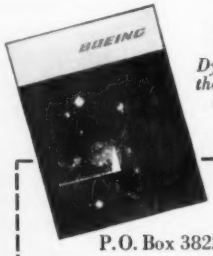
BOEING-DEVELOPED and built electronic counter-measures simulator, typical of many advanced areas of assignments open at Boeing in electronics. Openings also available in fields of infrared techniques, radar and beacon interrogator systems, electronic circuitry, and guidance and control systems, among others. Boeing research and development facilities are the most extensive in the industry. They could help *you* get ahead faster.



ANALOG COMPUTER installation used to simulate missile trajectory, ground control and terminal guidance. Boeing missile assignments are available on BOMARC, the nation's longest-range supersonic defense missile, and on Minuteman, an extremely advanced solid-propellant intercontinental ballistic missile system.



BOEING ENGINEERS attaching missile monitor plug for dynamic compatibility test of BOMARC interceptor. In addition to wide variety of simulated tests, BOMARC test firings are conducted at Cape Canaveral, Florida. Expanding Boeing projects offer engineers and scientists outstanding career openings, all with plenty of opportunities for advancement.



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Boeing Airplane Company,
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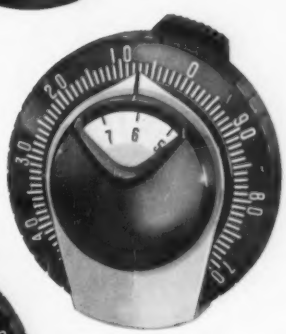
BORG MICRODIALS

add richness and style to control panels and instruments

A new concept in multi-turn counting dial styling . . . series 1360 Microdials by Borg. These new Borg Microdials were specially developed to harmonize with the design of present-day electronic equipment. Presently available in five color variations of red, gray and black. Borg has retained all the quality mechanical features that have made their Microdials famous . . . smoothness of operation . . . no jumping or step action . . . absence of noise . . . fewer ambiguities in reading due to human error. A contoured brake arm locks settings in place yet does not interfere with dial operation. Write for further data and prices.

SHOWN ACTUAL SIZE



BORG EQUIPMENT DIVISION

Amphenol-Borg Electronics Corporation

Janesville, Wisconsin

BORG

Al Mitchell takes the stand for electronics

I. Allen Mitchell is President and a founder of United Transformer Corporation, a company which placed its first advertisement in electronics more than 25 years ago.

United Transformer manufactures 700 stock items for virtually every application in the electronics field. Mr. Mitchell is a graduate engineer who entered college at the age of 14. At 16 he was the chief engineer of a transformer company and at 18 the director of engineering.

Do you, Mr. Mitchell, directly or indirectly influence the purchase of electronic equipment for your organization?

Naturally, I do.

Do you use the electronics BUYERS' GUIDE as your source book for electronic purchases?

Yes. I keep it available in my office at all times.

How long have you been a subscriber to electronics?

Since the day of its inception.

Why have you continued to pay for electronics when you can receive ten other electronic publications free?

To me electronics has a peculiarity. It has excellent technical coverage. It has the most pages of advertising, and naturally I want to keep abreast of the industry in terms of the products shown in the ads.

For a number of years your company has reserved the inside front cover of electronics for its sales messages. What is behind this decision?

Basically, we are a key manufacturer in our field for engineering products. As such we prefer to maintain a prestige position in the prestige magazine of our industry.

If it's about electronics, read it in electronics

electronics

Published WEEKLY plus the mid-year electronics BUYERS' GUIDE

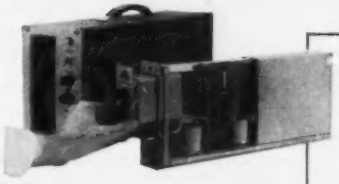
A McGraw-Hill Publication • 330 West 42nd Street, New York 36, N. Y.

Model A12's pass rugged military environmental tests for altitude, shock, temperature, humidity and electro interference.

Design and construction techniques used in the Model A12 amplifier are fully two years ahead of the field! These advanced techniques enabled the Model A12 to meet stiff environmental qualification tests which resulted in their being selected by Martin engineers for use in the *Titan* ground support equipment.

Use of totally transistorized circuits gives the A12 unmatched reliability and performance, and minimizes heat dissipation problems inherent in vacuum tube instruments. Plug-in etched circuit boards and modular internal construction make servicing and maintenance checks easy—the amplifier can be disassembled and reassembled in less than 10 minutes. *Your E-I representatives can give you complete information.*

Martin picks Electro Instruments D.C. Amplifiers for TITAN ground support equipment



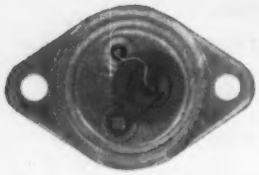
Plug-in attenuators of the A12 provide convenience, flexibility, economy. Special variations, gain settings, etc., can be tailored to your system at no extra cost.

- Totally transistorized—dissipates only 7 watts.
- Drift less than 2 microvolts for 200 hours.
- .01% linearity and stability.
- 100 megohms input impedance—40 milliohms output impedance.
- 1 db DC to 10 KC.
- Noise less than 10 microvolts wideband.
- Single ended or differential input.
- Operates to specifications from 0° to 50°C.
- Self-contained power supply—operates on any line frequency from 50-400 cps.
- Mil-type chopper gives unmatched reliability for the life of the instrument.
- 7" x 19" panel accommodates 8 instruments.

Electro Instruments, Inc. E I 3540 AERO COURT SAN DIEGO 11, CALIF.

BUILT-IN RELIABILITY

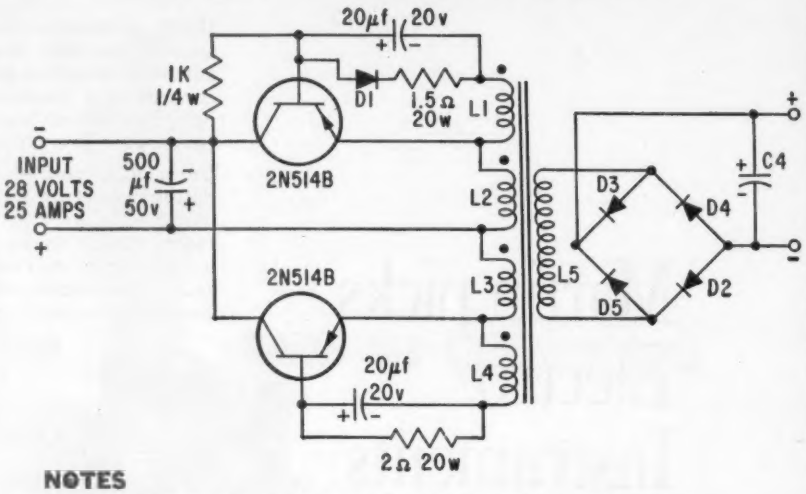
GERMANIUM TRANSISTOR APPLICATION NOTES



Low R_{CS} (0.05Ω) at high temperatures insured by large ring emitter-base area. Leakage currents minimized by all welded construction . . . no contaminating solders or fluxes used!

High current-carrying capacity and maximum safety against over-heating provided by heavy 90-mil emitter lead.

630 WATT DC-TO-DC POWER CONVERTER 90% EFFICIENT



NOTES

L5 may be wound according to the output voltage desired, allowing about 0.639 turns per volt. The wire size should be large enough to allow one circular mil per milliampere. The output current and load will then determine D2, D3, D4, D5, and C4.

L2, L3—17 turns each #10 bifilar wound

L1, L2—4 turns each #16

Core-type 50022-2A Magnetics, Inc.

Q1, Q2—2N514B 80 volt 25 amp each mounted on a minimum of 200 sq in. of ¼" aluminum for operation up to 50°C.

D1—1N1124 mounted on a minimum of 1 sq in. of exposed aluminum 1/16" thick. Operation to 50°C.

Frequency about 1 kc.

REDUCE YOUR COMPONENT COSTS WITH ONE TI POWER TRANSISTOR!

Save on overall costs and *up your circuit reliability* by selecting one *specific* TI germanium power transistor for your high power circuitry job. The need for transistor paralleling is greatly reduced . . . and, in many applications, eliminated . . . with TI's newest high current alloy-junction power transistor series. If you are using two types in parallel for a 25-amp job, save by using *one* TI high current alloy-junction transistor!

Ranging from 10 to 25 amps in 40, 60, or 80 volt types, all units feature guaranteed gain at maximum rated currents and *1.5 volts* V_{CB}. For your high current switching applications, all types highlight typical switching times at 25°C of 12.0 usecs (t_{on}) and 7.0 usecs (t_{off}).

Contact your nearest Texas Instruments sales engineer for applications assistance or your nearby TI distributor for off-the-shelf delivery at factory prices. For high reliability, high performance, and a full year product guarantee, you can rely . . . on TI!

maximum ratings at 25°C

		2N511	2N511A	2N511B	2N512	2N512A	2N512B	2N513	2N513A	2N513B	2N514	2N514A	2N514B	units
V_{CBO}	Collector-to-Base Voltage (I_C = −5ma, I_E = 0)	−40	−60	−80	−40	−60	−80	−40	−60	−80	−40	−60	−80	v
V_{CEX}	Collector-to-Emitter Voltage (V_{BE} = +0.2 v, I_C = −5ma)	−40	−60	−80	−40	−60	−80	−40	−60	−80	−40	−60	−80	v
V_{EBO}	Emitter-to-Base Voltage (I_E = −5ma, I_C = 0)	←		−30	→	←		−30	→	←		−30	→	v
I_C	DC Collector Current	←		−10	→	←		−15	→	←		−20	→	a
I_E	DC Emitter Current	←		10	→	←		15	→	←		20	→	a
I_B	Base Current	←					−5						→	a
	Total Dissipation	←					80						→	w
T_j	Junction Temperature	←					95						→	°C

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silicon diodes and rectifiers
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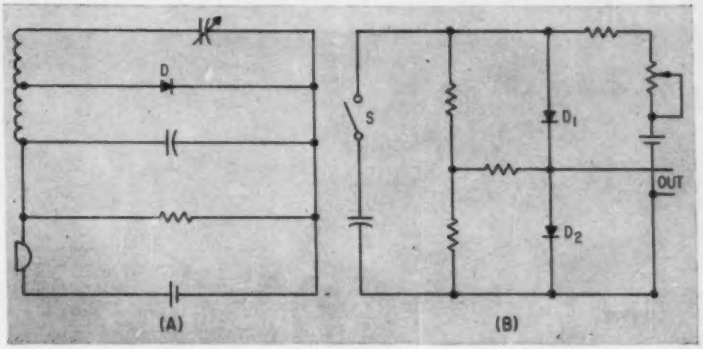

FIG. 1—Miniature f-m transmitter (A), flip-flop counter (B)

Tunnel Diode: Big Impact?

Some scientists predict new diode's influence will compare to that of transistor

SCIENTISTS of GE Research Laboratory, Schenectady, N. Y., predicted this week that the new tunnel diode (ELECTRONICS, p 82, June 12; p 69, July 10) will become a widely used component in electronics in the next few years. This diode may well have an impact on the electronics industry comparable to that of the transistor about 10 years ago, they said.

Characteristics

The tunnel diode resembles other semiconductor diodes in that it has a p and an n junction. However, the barrier, or space-charge depletion region of the tunnel diode is extremely thin, less than one-millionth inch.

It is this thin barrier that gives the diode its name and ability to respond to frequencies in the kmc range. Other qualities of the tunnel diode, such as the slope of its current-voltage characteristic, are attained by extreme care in fabricating the diode.

The tunnel effect describes the ability of electrons to travel across the barrier with the speed of light —or produce the same effect—even though the electrons do not seemingly have energy to surmount the barrier. It appears as though *phonons*—ultrasonic vibrations of the diode crystal lattice—may contribute the energy required by the electrons to get them over the barrier.

As diode forward bias is increased, current rises to a peak. After the peak, the current falls with increasing voltage, thus producing a negative-resistance region. Current drops to the bottom of a trough and then rises again. The negative-resistance portion of the characteristic may be used to amplify small input voltages. Figure 1A shows a miniature microphone-driven f-m transmitter which produces 0.1 mw between 90 to 120 mc. Here the diode functions as both oscillator and amplifier.

Use of the up-and-down current-voltage characteristic is illustrated in Fig. 1B. Initially, either diode conducts and the other diode is nonconducting. Momentary closing of switch S_1 exchanges conduction states of both diodes. Counting rates of 10 mc are possible now, with higher rates forecast for the future.

Applications

The following qualities give the tunnel diode remarkable promise for use in communication and computing equipment: high-frequency response (over 100 kmc is conceivable), low input-power requirement (about 1 mw), low noise figure (only the maser and parametric amplifier give lower noise), simplicity, and the ability to withstand environmental extremes (withstands nuclear radiation, works fine at few degrees above absolute zero, performs the same at 32 F and 600 F as at 70 F). Although present tunnel diodes handle 5 amperes (at a few tenths of a volt), future tunnel diodes will handle far more current.

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AVAILABLE IN 1-999 QUANTITIES:
Silicon transistors, germanium transistors, silicon diodes and rectifiers and carbon film resistors.

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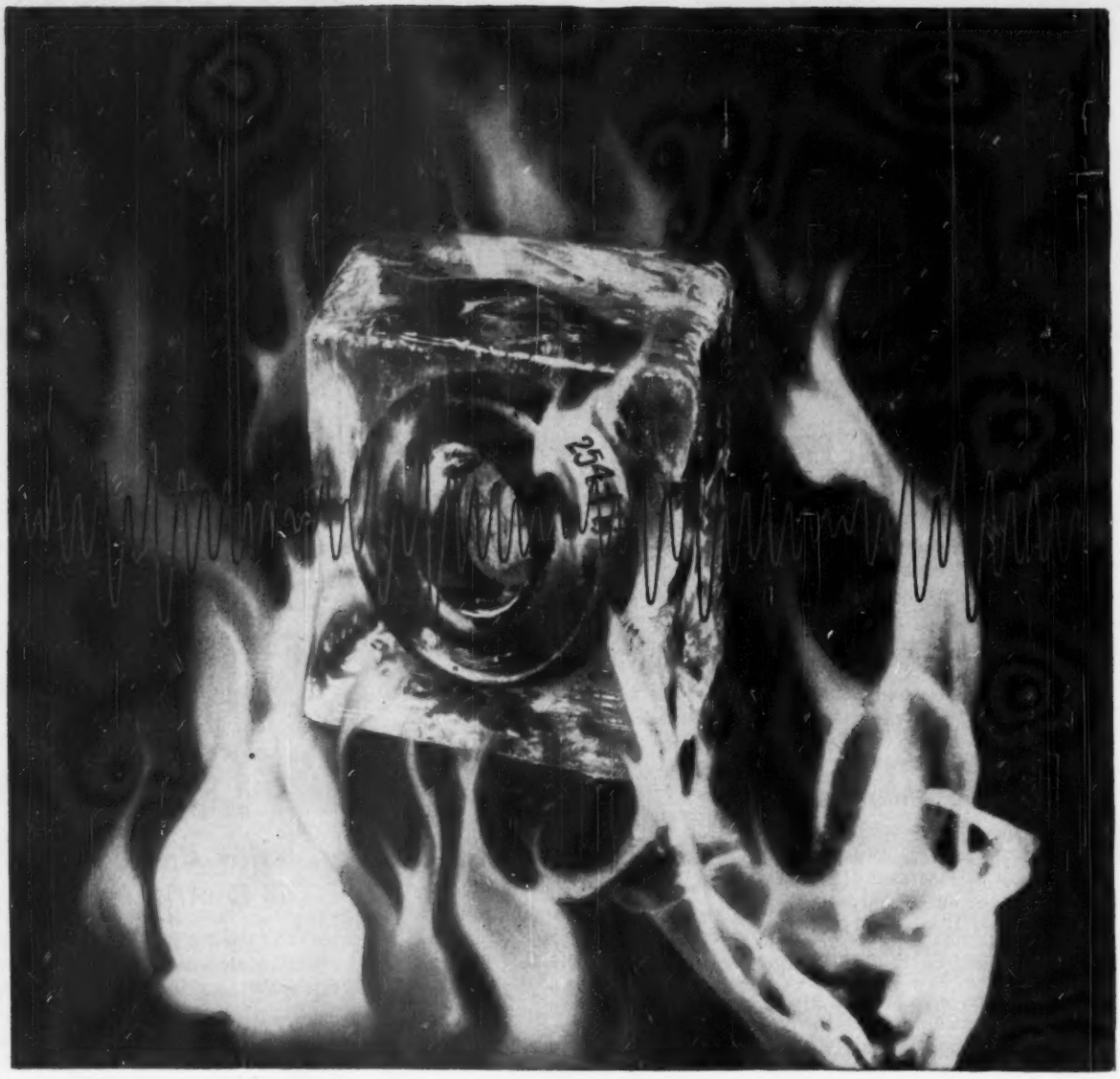


Hold your frequency under fire (and ice)!

New linear permalloy core keeps filters frequency-stable over a wide range of temperature conditions—at half the cost

Designers of audio filter networks, faced with the high price of components and the need for frequency stability over a wide swing in ambient temperatures, can now benefit from a most significant development—the linear molybdenum permalloy powder core.

The linear cores we've developed are used with polystyrene capacitors. This combination costs as little as half the price of temperature-stabilized moly-permalloy cores and the silvered mica capacitors with which they must be used.

What's more, frequency stability is increased! For temperatures ranging from −55°C to +85°C we have observed frequency stability variations as low as 0.05%. This is considerably less frequency shift than normally expected with temperature-stabilized combinations.

We guarantee the temperature coefficient of these linear cores within a very narrow range! Information regarding sizes, prices and performance behavior awaits your request. Popular sizes, in 125 permeability only, available immediately from stock. *Magnetics, Inc., Dept. E-74, Butler, Pa.*

MAGNETICS inc.

SEE US AT WESCON!

Cutting costs of Switch Installation... your job...and Centralab's

New!

Centralab Printed Circuit Switches

the greatest advance in switch design in decades

The CENTRALAB Series 20 Printed Circuit Switch provides these cost-saving advantages:

1. Elimination of switch wiring errors.
2. Simultaneous connection of all switching leads during dip soldering of etched circuit boards.
3. No hardware is required for rigid anchoring of switch to the board.

SPECIFICATIONS:

Construction: 1¾" high x 2" wide laminated phenolic sections. Bolted construction multiple sections and staked single or dual section assemblies.

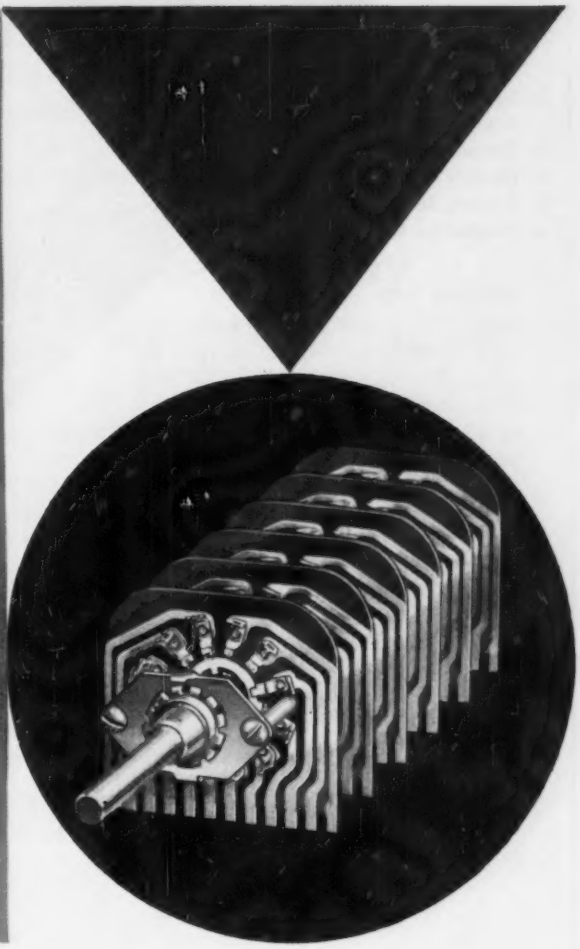
Switching Combinations: 1 pole—12 positions through 6 pole—2 positions. Also available with dual concentric shafts for A.C. line switch or ½ watt variable resistor, equipped with printed circuit terminals.

Rating: 2 amperes at 15 volts D.C., 150 ma. at 110 volts A.C. (make and break, resistive load).

Insulation: Laminated phenolic type PBE per specification MIL-P-3115. Voltage breakdown 1000 volts RMS.

Rotational Life: 10,000 cycles minimum.

For complete physical and electrical specifications on CENTRALAB Printed Circuit Switches ask for Bulletin EP-757.



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VARIABLE RESISTORS • ELECTRONIC SWITCHES • PACKAGED ELECTRONIC CIRCUITS • CERAMIC CAPACITORS • ENGINEERED CERAMICS

See these products at the 1959 Wescon Convention, Booth Numbers 3218-3220

NEW ZENER VOLTAGE TESTER*

Provides Automatic Presentation Of: zener diode voltage . . . transistor breakdown and zener voltage . . . diode inverse and reverse voltages. Also Tests For . . . zener diode impedance.

APPLICATIONS:

- *Laboratory Experimentation*
- *Circuit Design*
- *Quality Control*
- *Trouble Shooting*
- *Production Testing*

ERA's new Zener Diode Tester, Model DT100 is a self contained AC operated instrument designed for direct reading of zener voltage as a function of diode current. Provisions are also included for AC modulation of the diode current to permit the determination of zener impedance or zener slope for any given value of diode current. The instrument incorporates a wide range adjustable constant current generator which injects the desired value of current into the diode under test and maintains this current constant independent of line voltage fluctuations or zener voltage and impedance. The voltage appearing across the non-linear diode impedance is read directly by a high impedance DC voltmeter for the given current setting.

SPECIFICATIONS

Input Source	*115VAC, 60cps*
Zener Voltage Range	*0-300VDC*
Zener Current Range	*50 Microamperes-50ma*
Measurement Accuracy	*Better Than 2%*
Metering	*Direct Reading Ez, Iz*
Zener Impedance	*Provision for AC Modulation Iac, Eac Reading*
Physical	*Sloping Front Cabinet, Size: 12 x 8 x 19 inches*

Model DT100 $275.00

FOB Factory, Subject to change without notice

ERA manufactures a full line of transistor test equipment and transistorized devices. Write for complete technical bulletin on this (Catalogue #115) and related devices.

**Pat. Appl. For*

ELECTRONIC RESEARCH ASSOCIATES, INC.

67 Factory Pl., Cedar Grove, N. J. CEnter 9-3000 TWX NJ1144

SUBSIDIARIES

Era Electric Corporation • Nutley, N. J. Era Pacific Inc. • Santa Monica, Cal.

MEETINGS AHEAD

Aug. 17: Ultrasonics, National Symposium, PGUE of IRE, Stanford Univ., Palo Alto, Calif.

Aug. 18-21: Western Electronics Show and Convention, WESCON, Cow Palace, San Francisco.

Aug. 23-26: Electrical Conf. of the Petroleum Industry, AIEE, Wilton Hotel, Long Beach, Calif.

Aug. 23-Sept. 5: British National Radio & Tv Exhibition, British Radio Industry Council, Earls Court, London.

Aug. 24-26: Gas Dynamics Symposium: Plasma Physics, Magnetogasdynamics; American Rocket Society, Northwestern Univ., Evanston, Ill.

Aug. 24-27: Ballistic Missile and Space Technology, USAF, Space Technology Labs, Inc., Los Angeles.

Aug. 31-Sept. 2: Army-Navy Instrumentation Program, Annual Symposium, Douglas Aircraft and Bell Helicopter, Statler-Hilton, Dallas.

Sept. 1-3: Association for Computing Machinery, National Conf., MIT, Cambridge, Mass.

Sept. 3-6: Air Force Association's National Convention, Exhibition Hall, Miami Beach, Fla.

Sept. 7-12: Machine Searching and Translation, International Conf., Western Reserve Univ., Rand Devel. Corp., Western Reserve Univ., Cleveland.

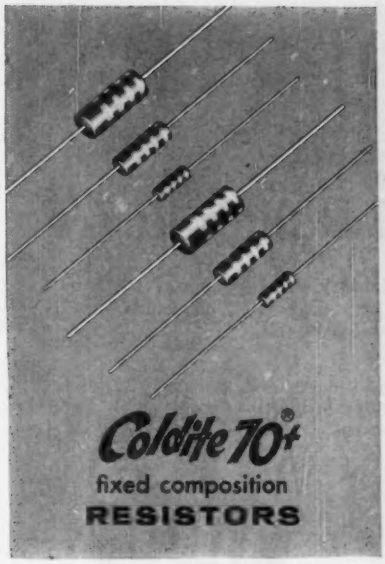
Sept. 17-18: Engineering Writing & Speech, Dual National Symposium, PGEWS of IRE, Sheraton-Plaza Hotel, Boston; Ambassador Hotel, Los Angeles.

Sept. 21-25: Instrument-Automation Conf. & Exhibit, ISA, International Amphitheater, Chicago.

Oct. 12-15: National Electronics Conference, IRE, AIEE, EIA, SMPTE, Sherman Hotel, Chicago.

Mar. 21-24, 1960: Institute of Radio Engineers, National Convention, Coliseum & Waldorf-Astoria Hotel, N. Y. C.

There's more news in ON the MARKET, PLANTS and PEOPLE and other departments beginning on p 138.



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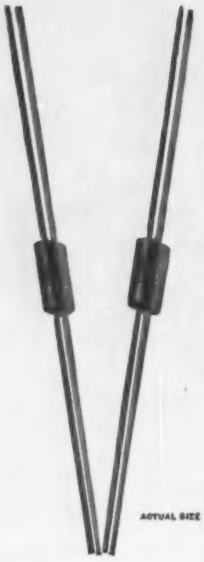
Electronic Components Division

STACKPOLE CARBON COMPANY, *St. Marys, Pa.*



Small-World Resistors with out-of-this-world Reliability

Miniaturization is a severe test of performance, for reliability tends to shrink faster than size. Here, where critical equipment had to be made smaller, yet more reliable, Bendix-Pacific pinned performance to the reliability of IRC precision film resistors.

IRC Molded Metal Film Resistors combine excellent stability on load with a low, controlled temperature coefficient that is far superior to other precision film resistors. They exceed requirements for extremely close design tolerances and have excellent high frequency characteristics. Where these superior characteristics are not required, IRC Molded Deposited Carbon Resistors offer excellent all-around performance and economy. Both types available in ⅛, ¼, ½, 1 and 2 watt sizes . . . and exceed MIL-R-10509B specifications. For design data, write for Bulletins B-3 and B-9.

IRC

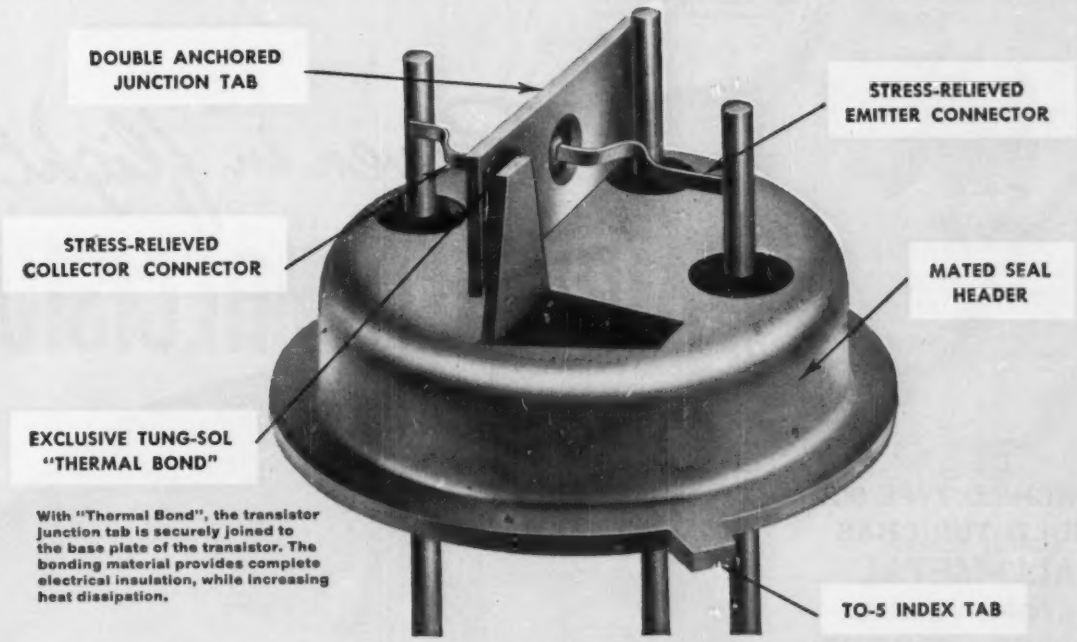
INTERNATIONAL RESISTANCE CO. • Dept. 378 401 N. Broad St., Phila. 8, Pa. *In Canada:* International Resistance Co., Ltd., Toronto, Licensee

New Subcarrier Oscillator typical of integrated reliability and miniaturization achieved in telemetry equipment by Bendix-Pacific Division of Bendix Aviation Corp., North Hollywood, Cal.

"THERMAL BOND"

EXCLUSIVE TUNG-SOL CONSTRUCTION

MEANS NEW STANDARDS OF TRANSISTOR PERFORMANCE IN COMPUTER APPLICATIONS



With "Thermal Bond", the transistor junction tab is securely joined to the base plate of the transistor. The bonding material provides complete electrical insulation, while increasing heat dissipation.

From Tung-Sol, originator of the Cold Weld Seal, comes a new design approach to greater mechanical reliability in computer switch transistors.

2N1313 (TS1000) is a PNP germanium alloy junction transistor which is designed for use in high current, high speed switching applications. This new transistor provides an ideal balance of the most wanted characteristics as revealed by survey of computer designers.

MAXIMUM RATINGS	
BV_{CBO}	−30V
BV_{EBO}	−20V
BV_{CEX} (V_{BE} = 0.1V)	−20V
BV_{CEO}	−12V
I_C (continuous)	400mA
I_C (peak)	1.0 A
T_j	−65°c to +85°c
P_C	175mW

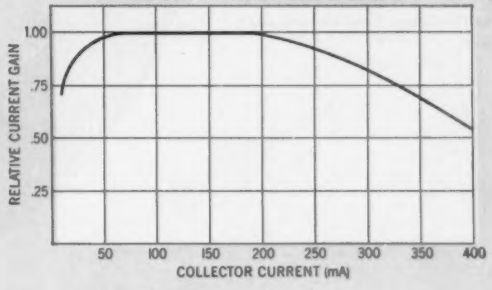
TYPICAL CHARACTERISTICS (25°C)	
f_{ab}	12 Mc
C_{ob}	12 μμf
h_{FE} (I_B = 1mA)	60
h_{FE} (I_C = 400mA)	40
(t_r + t_d) (rise plus delay)	0.45 μsec
t_s (storage)	0.30 μsec
t_f (fall)	0.20 μsec
Thermal Resistance	0.350° C/mW
I_{CBO} @ −12V	
25°C	2.5 μA
65°C	25 μA

1. Withstands 20,000 G centrifuge.
2. Exceeds all MIL environmental specs—shock—vibration—salt spray—centrifuge—moisture resistance, etc.
3. Excellent current gain linearity (low beta fall-off).
4. Thermal resistance derating is lowest for electrically insulated devices (.350° C/mW, typical).
3. Sensibly priced.

Immediate availability

Certainly, more information is available. Write: Tung-Sol Electric Inc., Newark 4, New Jersey

2N1313 BETA FALL-OFF CHARACTERISTIC



TUNG-SOL®

Proven in flight...

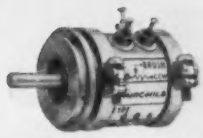
FAIRCHILD PRECISION

FAIRCHILD TYPE 909 MULTI-TURN HAS ALL-METAL • STOPS • SLIDER • ROTOR • HOUSING

There are no phenolic, plastic or other non-metallic materials in the type 909's mechanical components. This rugged, precision ⅜" diameter 10-turn potentiometer offers the utmost in reliability and performance.

The design can be built with linear as well as non-linear functions. It has low noise, good shock and vibration characteristics and excellent linearity (± 0.5% to ± .05%). Temperature range is —55°C to +90°C standard and to +150°C in high temp version. Several units can be ganged on a common shaft in from 3 to 20 turn configurations.

POTENTIOMETERS

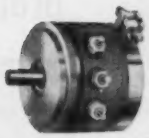


3-TURN High Reliability POTENTIOMETERS

This ⅞" dia. type 906 is one of three sizes offered by Fairchild. All feature exclusive long-life wiper guide mechanism.

10-TURN High Reliability POTENTIOMETERS

Available in ⅞" to 1 3/16" dia. and in 3 different designs to suit your needs. The 1" dia. type 920 shown above takes 30 G's at 2000 cps.



SINGLE-TURN LINEAR AND NON-LINEARS

Type 751 ⅞" dia. is one of 28 different types available in sizes up to 5". Functional accuracy over life is guaranteed — Fairchild's "Safety Factor" for reliability.

SINE-COSINE POTENTIOMETERS

Sizes 1⅛" to 5" dia. Built with Fairchild High Reliability resistance elements featuring top-wiped, shaped card windings which provide higher resolution and conformity regardless of position.

Having missiles fire as predicted is becoming more and more vital to the defense program. The reflection of this is the increased importance of the Reliability factor, or in a phrase the "*Predictable Excellence*", of components.

In the future less business will go to the unproven though low priced producer. Management has learned that the lowest initial cost does not always result in the lowest end cost.

Fairchild's precision potentiometers are *proven performers*. They are flying with *predicted excellence* in the nation's most important missiles and aircraft, some of which are illustrated above. They have a reputation for sustained high accuracy, lowest noise level and long life. As a result, Fairchild Reliability is fast becoming an industry standard.

For example, Fairchild High Reliability pots contain only high temp stabilized materials, welded terminations, and precious metal contacts. They are built to close dimensional and design control. And they are subjected to a continuing inspection and quality control program which includes torture testing 1 out of every 100 production units.

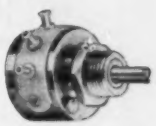
For more information write Dept. 26-E.

LINEAR MOTION POTENTIOMETERS

The flexibility of the type 910 design permits 1 or 2 resistance elements, and various stroke lengths. MIL-E-5272A environments are exceeded for the Fairchild Reliability "Safety Factor".

MINIATURE TRIMMING POTENTIOMETERS

⅜" dia. type 926 and ½" dia. type 927 exceeds MIL Std. 202A, rated 150° C. Metal case and precious metal contacts are Fairchild's reliability "Safety Factor".



SINGLE-TURN METAL FILMPOTS

Precious NOBL-OHM metal film resistance element offers infinite resolution, temperature operation to +225° C and low quadrature voltage.

FILMPOT 28-TURN TRIMMERS

For rugged environments and temperatures when infinite resolution and unsurpassed reliability is required. Available from stock.

RELIABILITY INSIDE THE BLACK BOX

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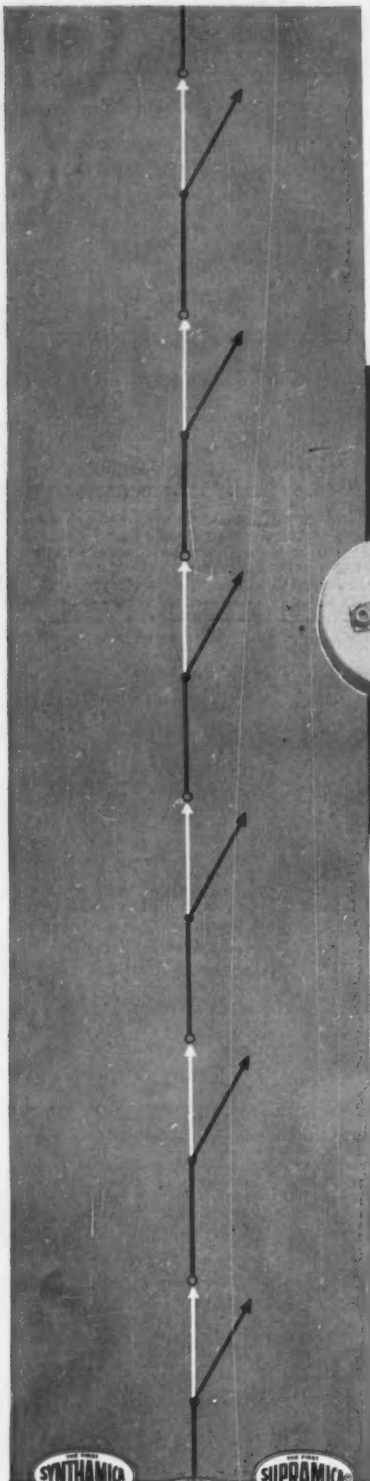
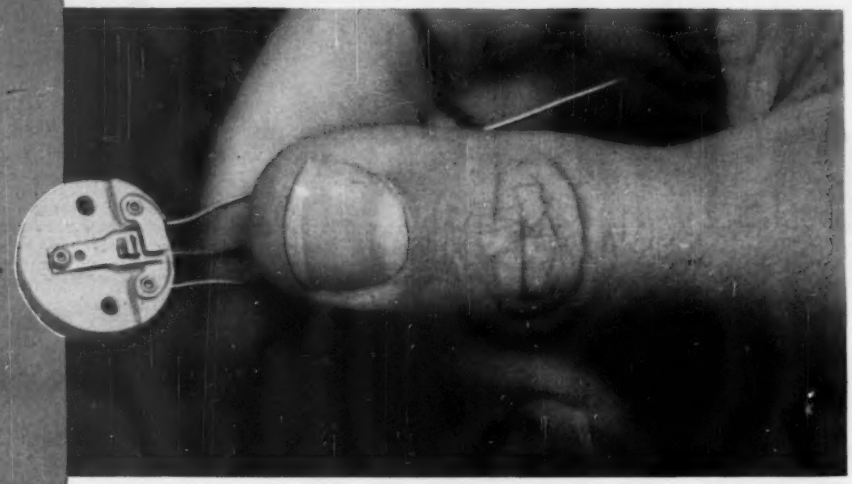
GYROS
PRESSURE TRANSDUCERS
POTENTIOMETERS
ACCELEROMETERS



SUPRAMICA® 560 ceramoplastic

the world's most nearly perfect precision-molded electronic insulation



gives this MICRO SWITCH assembly

A DIVISION OF MINNEAPOLIS-HONEYWELL

total dimensional stability!

This subminiature assembly—no bigger than your thumbnail—is a high-temperature switch, precision-made for the MICRO SWITCH Division of Minneapolis-Honeywell, and designed for use in missiles, aircraft and other electronic "hot spots." Precision-molded of SUPRAMICA 560 ceramoplastic, the switch base has *total dimensional* stability at temperatures up to +750°F in this application, and up to +932°F in many others. It has also been used in extreme *low* temperature applications as found in missile launching environments.

Reports MICRO SWITCH: "*Selection was founded on the characteristics of SUPRAMICA'S moldability, and dimensional stability and control. These are of utmost importance in the production and application of the 6SM switch.*"

"*It allows us to mold terminal inserts into the switch base, parallels the expansion characteristics of the stainless steel terminal inserts, and eliminates dimensional variations during a production run. This promotes extended switch life and helps MICRO SWITCH maintain the quality and reliability for which our products are known.*"

SUPRAMICA 560 is one of a unique family of precision-molded and machinable ceramoplastics and glass-bonded mica insulation materials. Whatever insulation characteristics you require, there is a Mycalex Corporation of America material to meet your need—for example, SUPRAMICA 620 machinable ceramoplastic offers a maximum operating temperature of +1550°F. Write today for specific information.

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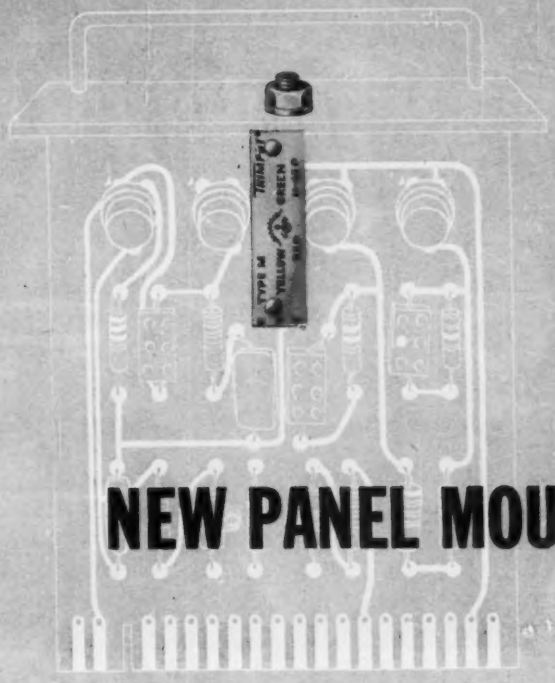
SEE US AT WESCON
BOOTHS 2810 – 2812



NEW PANEL MOUNT TRIMPOT®

Now, Bourns combines the convenience of a panel mount potentiometer with all the advantages of a rectangular unit—**Small Size:** requires 1/12 sq. in. or less of panel area—**Setting Stability:** self-locking shaft with no cumbersome locknuts—**Adjustment Accuracy:** multi-turn shaft provides up to 9000° rotation.

All of the many Trimpot models are now available with the panel mount feature as a result of a unique design that permits quick attachment of a panel mounting assembly to standard "on-the-shelf" potentiometers. Rugged stainless steel construction assures compliance to Mil-Specs for vibration, shock, salt spray, etc. Screwdriver adjustment is easily made from the front of the panel...recessed head prevents accidental changes of setting...silicon rubber O-ring and Teflon washer provide moisture barrier from outside elements.

Specify the panel mount Trimpot. Get reliability backed by years of engineering, manufacturing and field experience. **Write for complete data and list of stocking distributors.**

CHASSIS MOUNTING, PRINTED CIRCUIT OR PANEL MOUNTING—whatever your need, Bourns has a military or commercial potentiometer to meet your exact requirements. Choice of terminal types...resistances from 10 ohms to 1 Meg.

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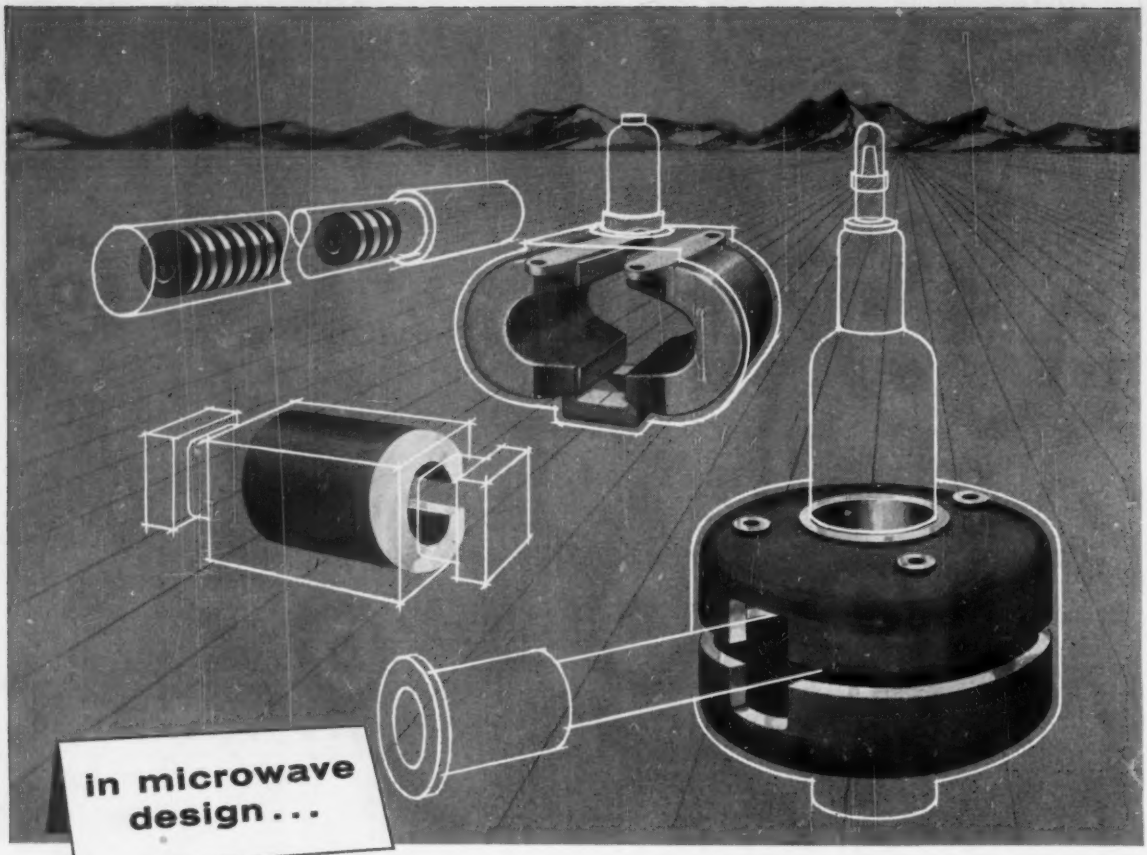
Exclusive manufacturers of Trimpot®, Trimit®. Pioneers in potentiometer transducers for position, pressure and acceleration.



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Application of permanent magnets in micro-wave devices has resulted in vastly improved performance, lower costs and greater stability. Since the early days of micro-wave research, The Indiana Steel Products Company magnet design engineers have worked closely with leading manufacturers, providing expert help in developing special-purpose permanent magnet assemblies for such applications as radar magnetrons, backward wave oscillators, pm-focus traveling wave tubes and load isolators.

A discussion with permanent magnet specialists at The Indiana Steel Products Company may be just the stimulus your new design efforts need — or perhaps you'll find a way to improve your present products. In any case, you can be sure of this — *nobody knows permanent magnets like Indiana.* And, because Indiana produces *all* permanent magnet materials, Indiana design engineers are well qualified to recommend the *one* best material for your design. Why not call in an Indiana man today?

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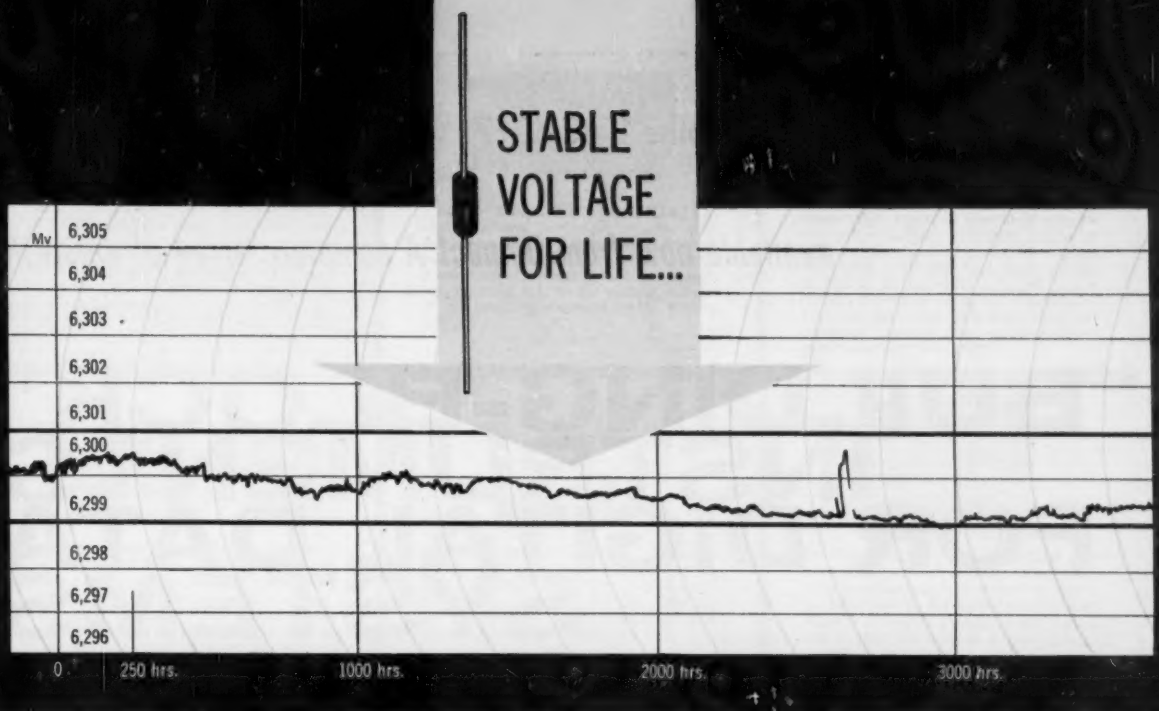

NEW ULTRA-STABLE ZENER DIODES

SPECIFICATIONS					RATINGS	
Type	Voltage Range at I_Z = 7.5 ma at 25°C (Volts) Min.	Max.	Temp. Coefficient[2] (−55°C to +100°C) at I_Z = 7.5 ma (%/°C)	Maximum Dynamic[3] Resistance at 25°C at I_Z = 7.5 ma (ohms)	Operating and Storage Temperature Range (°C)	Max. Operating Temp. at I_Z = 7.5 ma (°C)
1N821	5.9	6.5	±.01	15	−65 to +150	+125
1N822[1]	±5.9	±6.5	±.01	15	−65 to +150	+125
1N823	5.9	6.5	±.005	15	−65 to +150	+125
1N824[1]	±5.9	±6.5	±.005	15	−65 to +150	+125
1N825	5.9	6.5	±.002	15	−65 to +150	+125
1N827	5.9	6.5	±.001	15	−65 to +150	+125

[1]Double anode types.
[2]Determined by measuring a change of voltage from −55°C to +25°C and a change of voltage from +25°C to +100°C.
[3]The Dynamic Resistance is measured by superimposing a small A.C. Signal upon the test D.C. Current. ($I_{AC\ RMS} \leq 1/10\ I_{DC}$ Test)

1N822 and 1N824 types meet all specifications, including temperature coefficient, in both directions.

This new line of subminiature silicon voltage references features a combined lower dynamic resistance and voltage stability exceeding that of *any* standard cell.

Manufactured by diffusion, these devices offer temperature coefficients as low as 0.001%/°C. Unique single piece construction enables the reference to maintain excellent voltage stability when subjected to severe thermal shocks. Axial lead design and hermetically sealed glass encapsulation insure a rugged unit capable of providing long term reliability over wide ranges of environmental conditions.

These new subminiature references are also available in double anode types for symmetrical clipping applications.

Send for bulletin TE-1352.

Select from the nation's broadest line of regulators and references, including these types:

Rating	Type Number
250 MW	SV5 – SV24
250 MW	1N708 – 1N745
400 MW	1N746 – 1N759
750 MW	SV804 – SV824
1 WATT	1N1765 – 1N1802
10 WATT	SV904 – SV924

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"BUILDING-BLOCK" INSTRUMENTS FOR DIGITAL DATA SYSTEMS

Here is a practical approach that gives you, at no sacrifice in quality, a custom digital system at uniquely low cost.

The Dymec instruments shown here are specialized. Yet they are compatible, permitting a fully integrated system. Many can be used directly with printers, card punches, tape perforators and standard input/output equipment of other manufacturers. Dymec instruments are quantity-produced for obvious economies to you. Yet they are of finest quality, meeting the most rigid laboratory standards.

Many different systems can be assembled from these and other standard Dymec instruments. Dymec offers the instruments separately, as sub-systems, or as completely engineered, ready-to-use systems.

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For further information on Dymec instruments or systems, contact:

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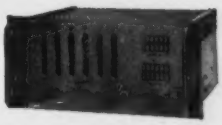
DY-2500 COMPUTING DIGITAL INDICATOR, variable gate time electronic counter permitting normalized direct reading with minimum controls, automatic setability. Measures frequency, period. Displays degrees/hr, gpm, RPM, etc.; also shows ratios of unlike variables. $1,330. One line readout, $1,505.

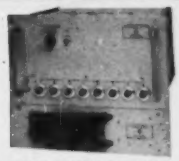


DY-2507 DUAL PRESET COUNTER, multi-purpose precision counter producing an output signal when either of two preset numbers is reached. Instrument is ideal for industrial control, sorting, packing, Go/No Go testing, control of coil winding, machine limits. $700 to $895.

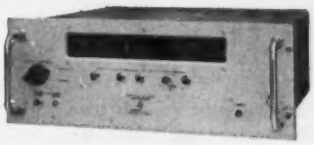
DY-2542 TAPE PUNCH SETS record data from electronic counters on punched tape. High speed—recording rate 60 characters/second. Standard model: 5-level output code, 11 character format. Available with internal tape punch ($4480) or for use with external punch ($3240). For lower rates (20 characters/second) DY-2540 Scanner/Coupler, transfers counter data to serial entry machines. DY-2540, $890.

DY-2210 VOLTAGE TO FREQUENCY CONVERTER AND INTEGRATOR provides precision dc voltage measurements and integration with electronic counters. Multiple input ranges, either polarity. Input 0 to 1 v produces 0 to 10,000 cps output. $650. AC and remote models available.

DY-2504A PHOTOELECTRIC TACHOMETER measures shaft speeds, revolutions, position from 0 to 10,000 RPM. Six models, offering 60, 100, 120, 180, 200 or 360 pulses/revolution. High resolution, low torque. $250.

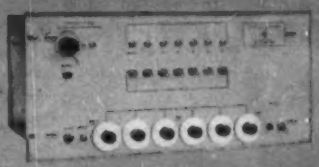


DY-2512 CARD PUNCH COUPLER permits direct entry of counter information onto punched cards, eliminating manual key punch. Operates unattended. Readily connects Dymec or -hp- counters to IBM 523 Summary Card Punch. $1,890.



DY-2508 DIGITAL CLOCK continuously displays and provides parallel, multiple-contact closure, representing time-of-day in hours, minutes, seconds. 1-, 4- or 10-line code output. Inherent short time storage permits independent clock and recorder operation. $1,350 plus code wiring.

DY-2538 PROGRAMMED DIGITAL COMPARATOR. Unique, error-free comparison circuit, no drift or calibration; visual and electrical output; use with Go/No Go systems. Preset high and low tolerance limits selected electrically. Also manual-selection models. $950.



DY-2513 COUNTER SCANNER. Gathers multiple electronic counter data for printing on a single digital recorder. Simplifies simultaneous data measurements. For all Dymec or -hp- counters. $1,750.

DY-2530 BINARY/DECIMAL REGISTER. Universal output coupler connecting electronic counters to digital displays, comparators, printers, computers. Stores parallel binary-coded-decimal information in multi-contact relays. 10 models, dual or single output, 3 to 7 registers. $565 to $1,230.

DY-2533 DIGITAL DISPLAYS. Luminous, one-line indicator panels visually presenting multi-digit numeric data. Clear, high contrast, easy-to-read numerals. Five models, 3 to 7 digits. $140 to $300.

dy

DYMEC INC.

Electronic Instrumentation Systems

Dept. E8, 395 Page Mill Road
Palo Alto, California
DAvenport 6-1755

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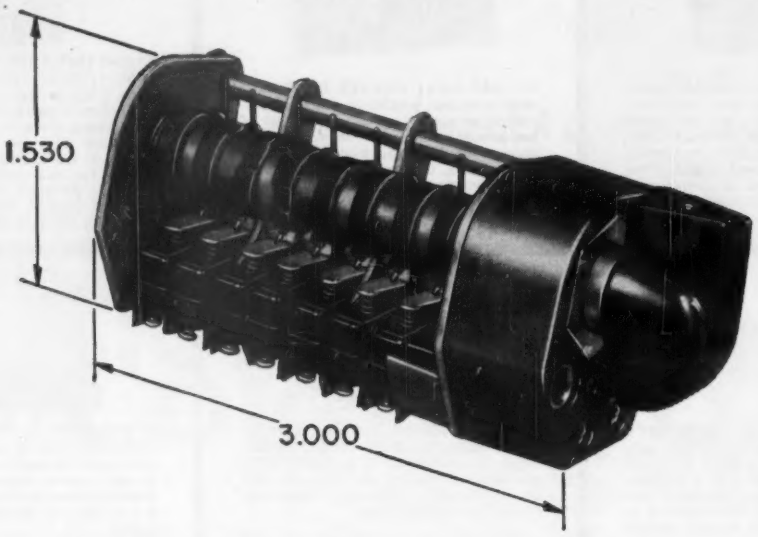
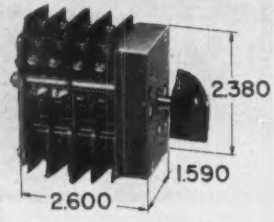
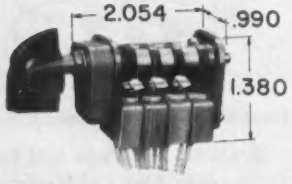


New rotary selector switch assemblies feature "cock-and-fire" actuation

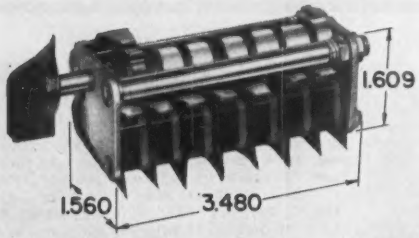
OTHER ROTARY ASSEMBLIES



"20AS" series double-row "V3" assembly (Knob not furnished)



"25AS" series sealed subminiature assembly (Knob not furnished)



"7AS" series single-row "V3" assembly (Knob not furnished)

The new "28AS" Series of rotary selector switch assemblies have a "cock-and-fire" actuating mechanism that moves positively from one position to another, imparts a good feel of the detent action and provides immediate indication of each position. Aircraft engineers have found these switches ideal for mounting in close-coupled designs. Features include:

Reliable Operation

Individual actuating levers pivot on a common rod, insuring maintained adjustment. The levers are operated by precision cams which are rigidly mounted on the actuator shaft. A seal ring on the shaft keeps out moisture. Panel seals are optional.

"Non-Tease" Circuitry

The actuating mechanism moves positively from one position to another. There is no possibility of circuit "tease" or actuator "hang-up" between the 90° detents.

Variety of Sequences

Up to seven basic switches and two or three actuator positions may be provided. Innumerable sequences can be factory-adjusted to fit specific circuit requirements.

Send for Data Sheet 162

For information of the "28AS" Series or other versatile MICRO SWITCH rotary switches, consult experienced engineers at your nearby branch—or write to:

MICRO SWITCH . . . FREEPORT, ILLINOIS
A division of Honeywell
In Canada: Honeywell Controls Limited, Toronto 17, Ontario

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MICRO SWITCH Precision Switches

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The reliability of the microwave components and equipment used in the Air Force's BOMARC Missile Ground Support System is safeguarded by production and field tests using LFE ultra-stable microwave oscillators and LFE microwave stability testers . . . instruments created and manufactured by LFE because the need for exceptionally high reliability existed. This is but one of many creative contributions to the nation's defense resulting from LFE *Leadership from Experience.*

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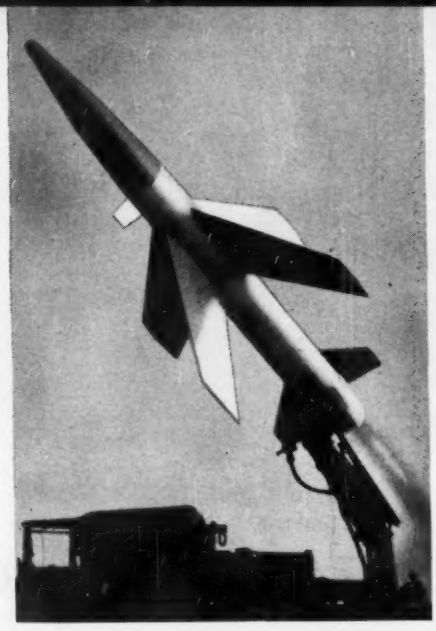
MISSILE PROJECTS USE JERROLD 900A

the industry's most versatile

SWEEP GENERATOR

Helps Martin Orlando develop guidance systems for such missiles as the Army's Lacrosse and the Navy's Bullpup. This one instrument covers all needs from ½ MC to 1200 MCS, for IF's, radar, video, telemetering and communications!



Specifications: In two ranges—0.5 MC to 400 MC and 275 MC to 1200 MC—with center at any frequency from 500 KC to 1000 MC and with sweep widths as broad as 400 MC and as narrow as 100 KC. The RF output—is flat within ±0.5 db at full sweep width up to 800 MCS and ±1.5 db from 800 MCS to 1200 MCS. When using sweep widths as narrow as 20 MCS flatness is approximately ±0.15 db.

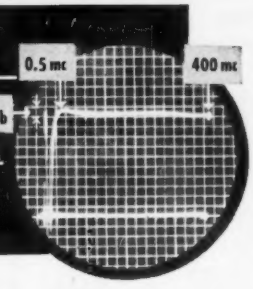
$1260.00

Write today for on the spot demonstration of Jerrold 900A!

***HIGH OUTPUT!**
.25 volt RMS on VHF—.5 volt RMS on UHF!

***WIDE SWEEP WIDTHS!**
VHF—100 KC to 400 MCS.
UHF—100 KC to 40% or more of C.F.

***FLAT OUTPUT!**
Flat to ±.5 db on widest sweep width!



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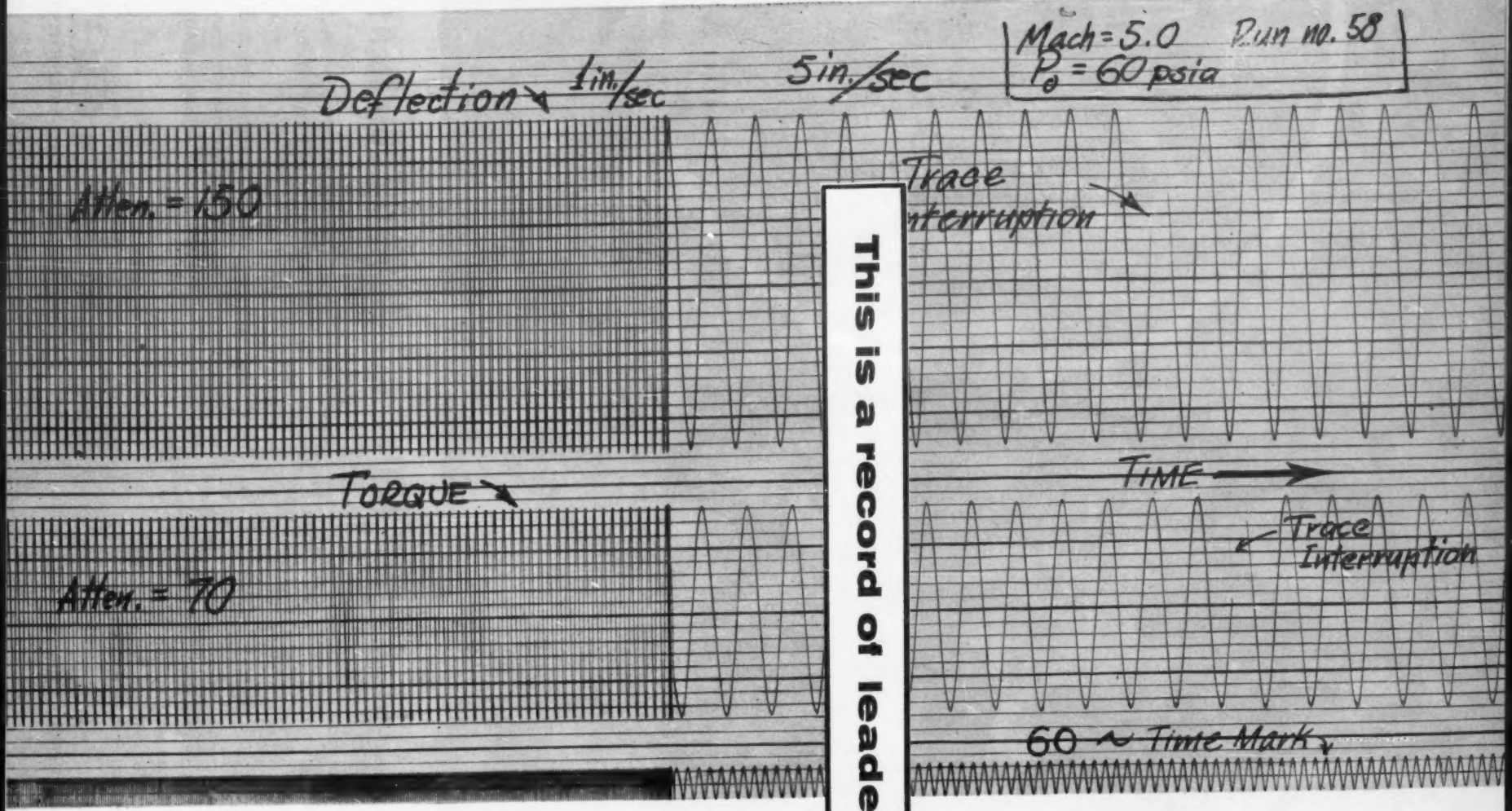


This is a record of leadership

Honeywell 906A Visicorder record, actual size. Note longitudinal grid lines and trace identification interruptions.

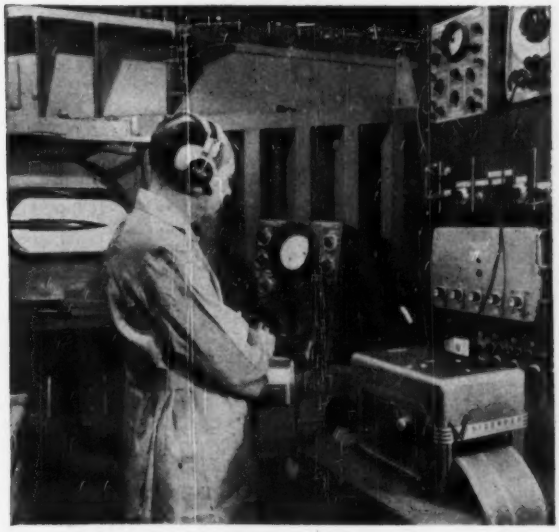
These studies of aerodynamic damping coefficients on an airframe were made by engineers at ARO, Inc. They were conducted in the Gas Dynamics Facility at the U.S.A.F.'s Arnold Engineering Development Center, Tullahoma, Tennessee, wind tunnel center of the Air Research and Development Command.The studies were directly recorded on a Honeywell 906-A Visicorder.

The problem: To measure damping-in-pitch derivatives for a clipped-delta-wing-body configuration over a Mach number range of 2.0 to 5.0 so that these measurements could be compared with the Mach number trend predicted by theory.

The set-up: A model of the delta-wing body, mounted on its cross-flexure pivot support, was forced to oscillate through a linkage by an electro-magnetic shaker. Resistance strain gauges were bonded to the input torque member and to one of the pivot supports. These gauges supplied torque and displacement signals through a carrier amplifier to two galvanometers in the Visicorder. An oscillator, driving a third galvanometer, established a time base for the oscillogram.

The values discovered through this forced-oscillation balance system experiment showed some discrepancies from values predicted by theory, because the theory pertained to simpler bodies than that used in the tests. The experiments provided a new set of data which will result in more accurate predictions for future design.

in aerodynamic research



Z. A. Woodard, Jr., ARO, Incorporated, instrument technician, operates the Visicorder in the measurement of aerodynamic damping coefficients.

The Honeywell Visicorder is the pioneer and unquestioned leader in the field of high-frequency, high-sensitivity direct recording oscillography. In research, development and product testing everywhere, instantly-readable Visicorder records are pointing the way to new advances in product design, rocketry, computing, control, nucleonics . . . in any field where high speed variables are under study.

The new Model 906A Visicorder, now available in 8- and 14-channel models, produces longitudinal grid lines simultaneously with the dynamic traces, time lines, and trace identification by means of new accessory units.

To record high frequency variables—and monitor them as they are recorded—use the Visicorder Oscillograph. Call your nearest Minneapolis-Honeywell Industrial Sales Office for a demonstration.

Reference Data: Write for Visicorder Bulletin
Minneapolis-Honeywell Regulator Co.,
Industrial Products Group, Heiland Division
5200 E. Evans Ave., Denver 22, Colo.

Honeywell

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CIRCLE NO. 81 READER SERVICE CARD

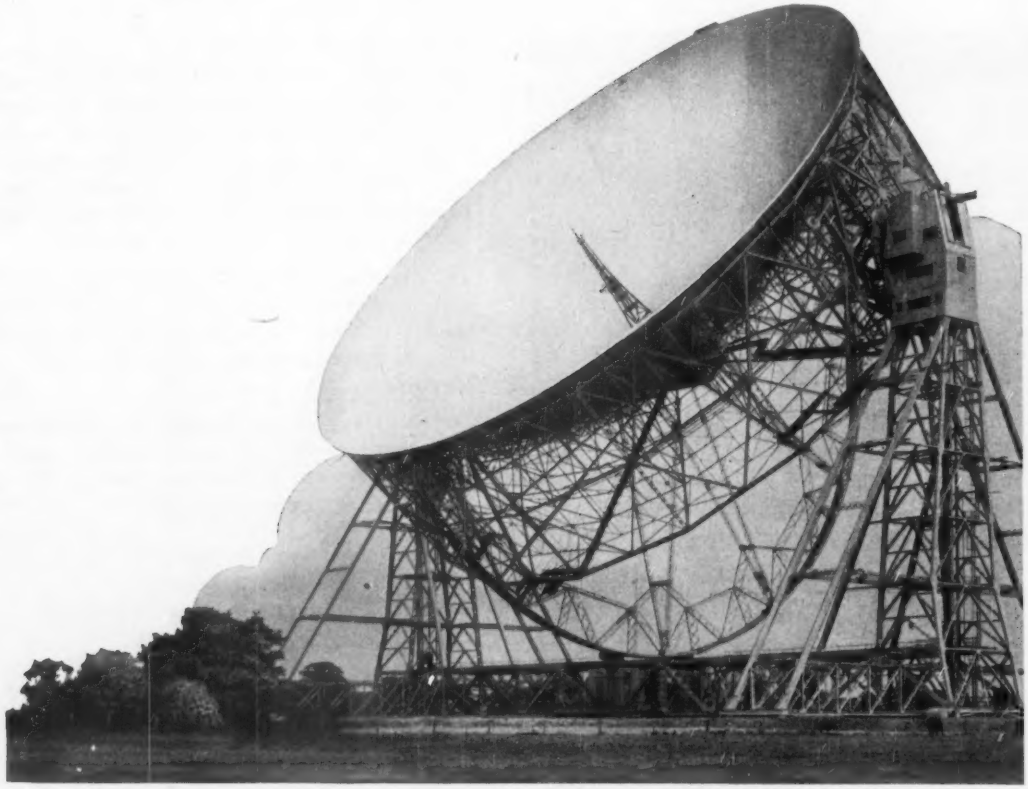
"Britain calling America ... via the moon"

MAY 14th, 1959.

A new chapter in communications history was opened when scientists from Manchester University at Jodrell Bank transmitted the first messages in morse code and speech to America via the moon.

The transmitting and receiving equipment which successfully sent the messages a distance of half a million miles was designed and manufactured by Pye telecommunications engineers.

Foremost in design and manufacture Pye Telecommunications equipment is today solving communications problems in more than 90 countries throughout the world . . . *tomorrow in space.*



Photograph by courtesy of the Director of the Jodrell Bank Experimental Station

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NATVAR Styroflex® Film

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These SEC Polystyrene Capacitors have an accuracy in the order of 0.1% or better and longtime stability in the order of 0.03%. Natvar Styroflex film is used as the dielectric.

SOUTHERN ELECTRONICS CORPORATION, Burbank, California, manufactures precision capacitors for applications where difficult specifications have to be met, such as computer integrators, test equipment, secondary standards and certain weapons programs.

Because polystyrene comes closest to meeting specifications for a perfect dielectric, various polystyrene films were tested. Natvar Styroflex film was selected because of its uniformly excellent pliability, freedom from faults, high shock resistance and excellent dielectric characteristics.

Natvar Styroflex film is available in standard thicknesses From .0004" to .006" in widths from ½" to approximately 10" or in special put-ups to meet manufacturing requirements.

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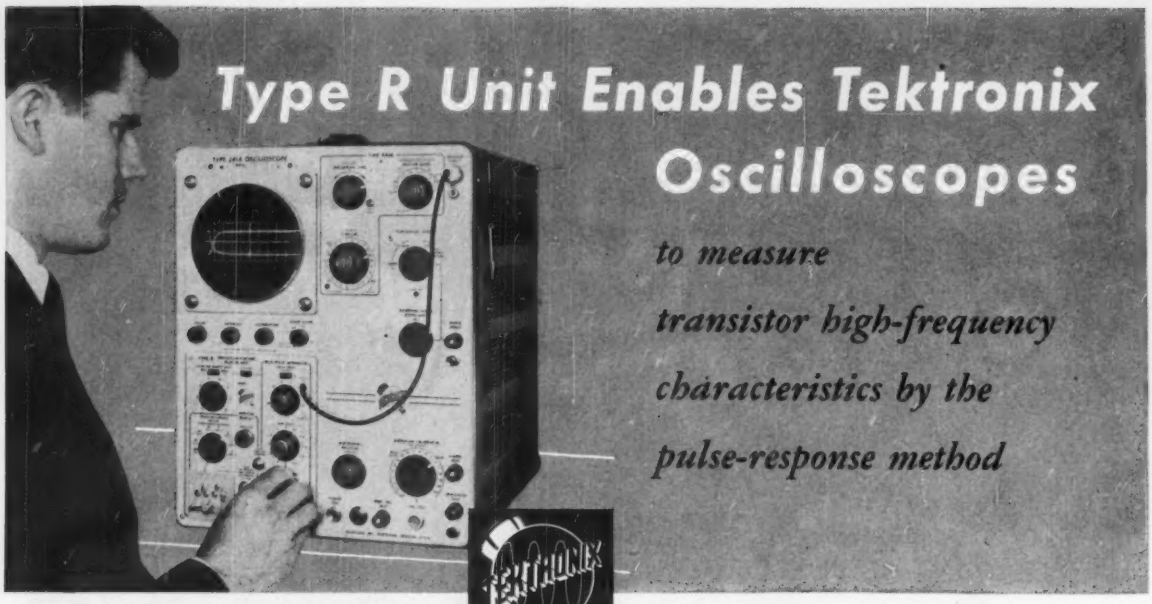


Type R Unit Enables Tektronix Oscilloscopes

to measure transistor high-frequency characteristics by the pulse-response method

TYPE R TRANSISTOR-RISETIME PLUG-IN UNIT CHARACTERISTICS

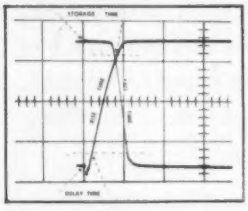
Collector Supply 1 to 15 v continuously adjustable, positive or negative. Current capability—400 ma.

Mercury-Switch Pulse Generator Risetime less than 5 mμsec, amplitude 0.02 v to 10 v across 50 ohms, positive or negative. Overall risetime with Type 541A: 12 mμsec. Overall risetimes with other Tektronix Oscilloscopes—Types 543, 545A, 555: 12 mμsec—Type 551: 14 mμsec—Types 531A, 533, 535A: 23 mμsec.

Bias Supply +0.5 to −0.5 v and +5 v to −5 v, continuously variable.

Calibrated Vertical Deflection 0.5, 1, 2, 5, 10, 20, 50, and 100 ma/cm collector current.

Type R Transistor-Risetime Unit **$300**



The Type R Unit can trigger the Oscilloscope sweep either on the start of the test pulse only, or on both the start and finish to display delay, rise, storage, and fall times simultaneously.

TYPE 541A CHARACTERISTICS

Vertical Response DC-to-30 MC passband, 12-mμsec risetime, 50-mv/cm deflection factor with Type K Plug-In Preamplifier.

Signal-Delay Permits observation of leading edge of signal that triggers the sweep.

Versatility—Other Plug-In Preamplifiers available for many specialized applications.

Sweep Range 0.1 μsec/cm to 5 sec/cm in 24 direct-reading steps. 5-x magnifier increases calibrated range to 0.02 μsec/cm. Continuously adjustable from 0.02 μsec/cm to 12 sec/cm.

Triggering Fully automatic, or amplitude-level selection with preset or manual stability control.

Accelerating Potential 10 kv for bright display with fast sweeps and low repetition rates.

Amplitude Calibrator 0.2 mv to 100 v in 18 steps. Square wave, frequency approximately 1 kc.

Regulation Electronically-regulated power supply.

Type 541A, without plug-in units **$1200**

Type K Plug-In Preamplifier **$135**

Prices f.o.b. factory.

The Type R Transistor-Risetime Unit, when plugged into a Tektronix Oscilloscope, supplies a fast-rising pulse and the required supply and bias voltages for measurement of transistor rise, fall, delay, and storage times. The Type R Unit can be used with all Tektronix Type 530 Series, Type 540 Series, and Type 550 Series Oscilloscopes.

When the Type R Unit is used with the Tektronix Type 541A Oscilloscope, risetime of the combination is 12 mμsec. The Type 541A is a fast-rise general-purpose oscilloscope that adapts to many specialized applications through its plug-in vertical preamplifier feature. Nine plug-in preamplifiers are presently available, others will be announced in the near future.

Please call your Tektronix Field Engineer for complete details. If desired, he can arrange a demonstration in your own application.

ENGINEERS—interested in furthering the advancement of the oscilloscope? We have openings for men with creative ability in circuit and instrument design, cathode-ray tube design, and semiconductor research. Please write Richard Ropiequet, V.P., Eng.

Tektronix, Inc.

P. O. Box 831 • Portland 7, Oregon

Phone CYpress 2-2611 • TWX-PD 311 • Cable: TEKTRONIX

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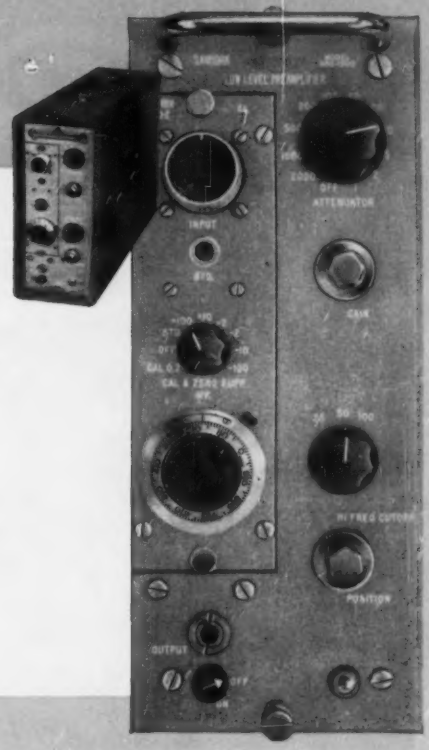
LOW LEVEL INPUT AMPLIFICATION

- *1,000,000:1 rejection ratio at 60 cps*
- *floating input*
- *isolated output*

IN 2 NEW SANBORN CHOPPER AMPLIFIERS



INDIVIDUAL SET-UPS

portable, self-contained unit amplifier

The Model 350-1500 Low Level Amplifier provides extremely versatile measurement of low level signals through use of two interchangeable plug-in circuits — one for thermocouple applications, another for DC strain gage work (other plug-ins now in development). Floating input and isolated output make the 350-1500 useful when signal measurements are made in the presence of large ground loop voltages. The 10-1/2" high x 4-3/16" wide 350-1500 may be used individually with its own power supply to drive a 'scope, meter, optical element, etc. or as a preamplifier in 6- or 8-channel 350 series recording systems.

MULTI-CHANNEL INSTALLATIONS

8-unit 7" high modules for "850" series direct writers

Compact Model 850-1500A Low Level Preamplifiers are economical, space-saving units for large installations such as aircraft and missile development and test facilities where many recording channels are used to monitor strain gage and thermocouple outputs. Required 440 cps chopper drive voltages can be supplied for up to 16 channels with the *Model 850-1900 MOPA.*

SPECIFICATIONS

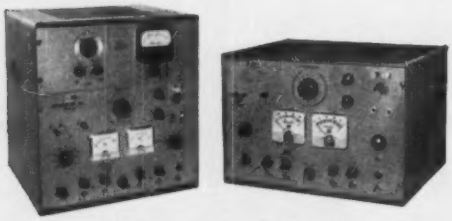
	350-1500	850-1500A
Sensitivity	20 uv input for 1 volt output, or 10 chart div. with Sanborn recorder; X1 to X2000 attenuator	100 uv input for 1 volt output, or 10 chart div. with Sanborn recorder; X1 to X200 attenuator
Input	Floating, can be grounded	
Input Impedance	100,000 ohms	200,000 ohms
Output	Floating or grounded (independent of input)	
Output Impedance	350 ohms	
Output Capabilities	±2.5 volts across 1000 ohm load	
Bandwidth	DC – 100 cps (3db)	
Linearity	±0.1% of full scale	
Common Mode Performance	120 db for 60 cps and 160 db for DC with 5000 ohms unbalance in source	
Noise	2 uv peak-to-peak over a 0 to 100 cps bandwidth	
Drift	±2 uv for 24 hours	
Gain Stability	±0.1% for 24 hours	

(specifications subject to change without notice)

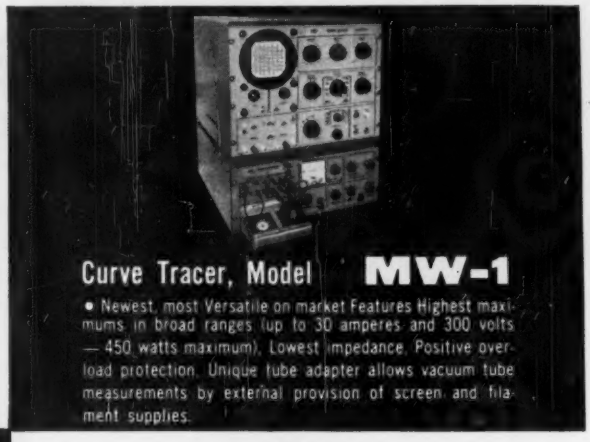
Complete specifications and application data are available from Sanborn Sales-Engineering Representatives in principal cities throughout the United States, Canada, and foreign countries.

SANBORN COMPANY
INDUSTRIAL DIVISION
175 Wyman Street, Waltham 54, Mass.

COMPLETE LINE OF TRANSISTOR TEST EQUIPMENT

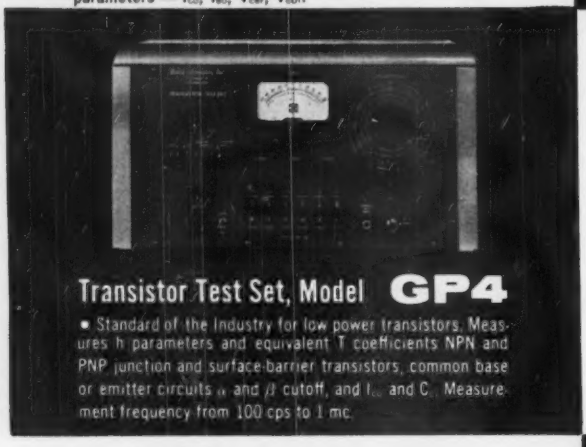


General Purpose Transistor Test Set, KP-2 Series • **Research and quality control with maximum reliability** • **Direct Precision Measurements** • **Up to 2 amps 200v.** Based on h parameters using basic straight forward circuitry. Features common bases or emitter, direct measurement of h parameters plus α and β cutoff. Meter indication of DC parameters — I_{co}, I_{eo}, V_{cer}, V_{ebr}.



Curve Tracer, Model MW-1

• Newest, most Versatile on market Features Highest maximums in broad ranges (up to 30 amperes and 300 volts — 450 watts maximum). Lowest impedance. Positive overload protection. Unique tube adapter allows vacuum tube measurements by external provision of screen and filament supplies.



Transistor Test Set, Model GP4

• Standard of the industry for low power transistors. Measures h parameters and equivalent T coefficients NPN and PNP junction and surface-barrier transistors, common base or emitter circuits α and β cutoff, and I_{co} and C. Measurement frequency from 100 cps to 1 mc.

Beta Tester, Model KT-1

• Lightweight • Portable • Easy to use. Measures Betas h_{fe} and I_{co}. This completely self-contained unit features a transistorized 1 kc oscillator and batteries, printed-circuit construction and meter overload protection.

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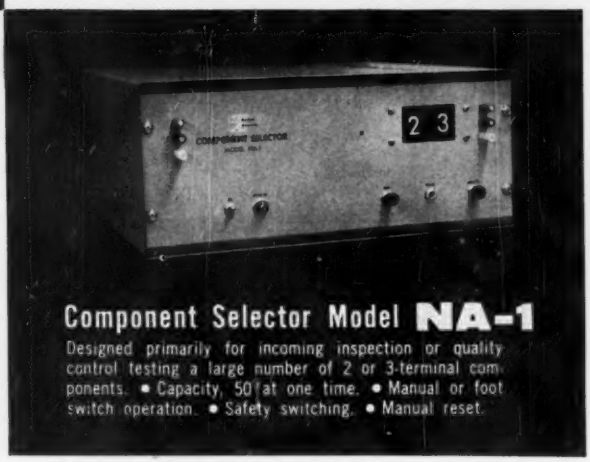

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V_{cb} max.	50	60	80	80	80 volts
I_c max.	5	5	5	5	7 amp.
I_{co} (V_{cc} 2 volts) Typical 25°C.	65	65	65	65	65 μa.
HFE (3 amp.)	–	60-150	30-75	30-75	–
HFE (5 amp.)	–	–	–	–	20-50
AC Power Gain (I_c=0.6 amp.)	37 DB	–	–	–	–
V_{ceo} (I_c = 1 amp.)	40 typical	50 typical	60 min.	60 min.	60 volts min.
Thermal Gradient max.	1.5	1.5	1.2	1.2	1.2° c/w

Delco Radio rounds out its power transistor line with this new 5-ampere germanium PNP series. Types 2N1168 and 2N392 are specially designed for low-distortion linear applications, while 2N1159 and 2N1160 are outstanding in reliable switching mode operations.

Type 2N1011 is designed to meet MIL-T-19500/67 (Sig. C). It joins 2N665, MIL-T-19500/68 (Sig. C); 2N297A, MIL-T-19500/36 (Sig. C) and JAN2N174, MIL-T-19500/-13A to provide a selection for military uses.

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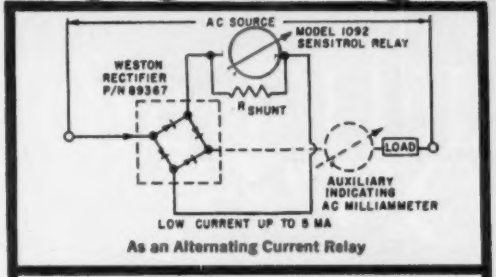
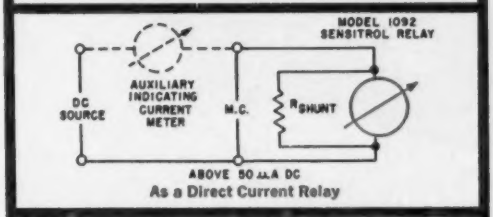
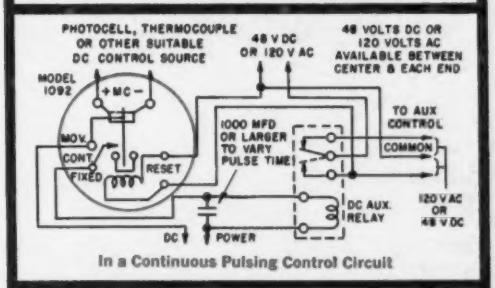
1092 SENSITROL®



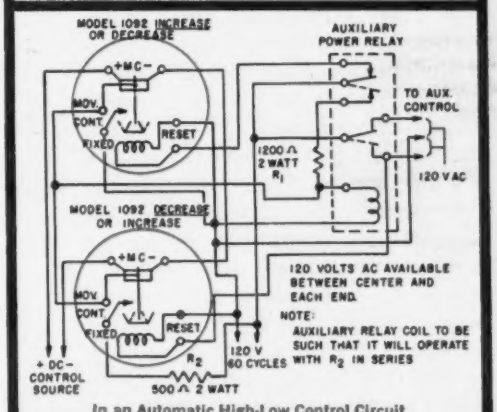
As an Alternating Current Relay

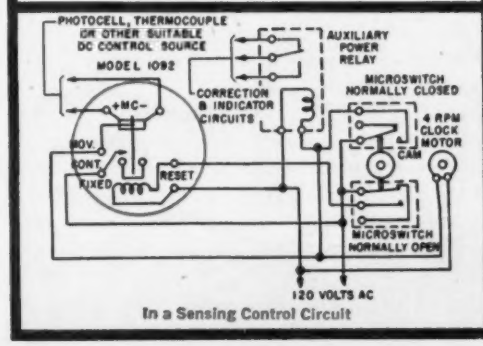


As a Direct Current Relay



In a Continuous Pulsing Control Circuit


MODEL 1092 INCREASE OR DECREASE
AUXILIARY POWER RELAY
TO AUX. CONTROL
1200 Ω 2 WATT R1
120 V AC
MODEL 1092 DECREASE OR INCREASE
120 VOLTS AC AVAILABLE BETWEEN CENTER AND EACH END.
NOTE: AUXILIARY RELAY COIL TO BE SUCH THAT IT WILL OPERATE WITH R2 IN SERIES
+ DC − CONTROL SOURCE
R2
500 Ω 2 WATT
120 V 60 CYCLES
In an Automatic High-Low Control Circuit



In a Sensing Control Circuit

the versatile relay

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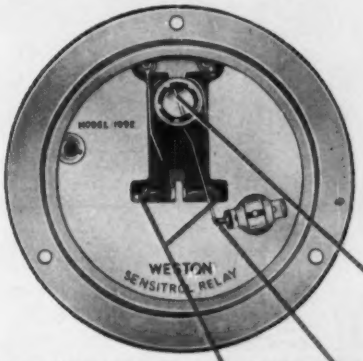

In breadboard circuits, the 1092 makes it unnecessary to pinpoint electrical operating values through elaborate calculations or measurements. A single, movable contact adjuster (1) provides variable and accurately repeatable settings. In production equipment, the 1092 eliminates the need for stocking a variety of relays.

Model 1092's contain built-in reset mechanisms (2) and chatter proof locking magnetic contacts (3). They can be set to close at any value of D-C from 5 to 50 microamps, or a comparable millivolt span of 10 to 100 . . . and will handle 100 milliamps at 120 volts A-C or D-C.

For full information, or for the address of your nearest distributor, contact your local Weston sales office . . . or write to Daystrom-Weston Sales Division, Newark 12, N. J. *In Canada: Daystrom Ltd., 840 Caledonia Rd., Toronto 19, Ont. Export: Daystrom Int'l., 100 Empire St., Newark 12, N. J.*

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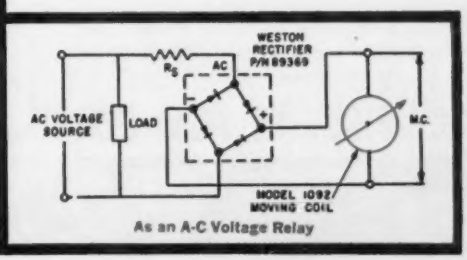

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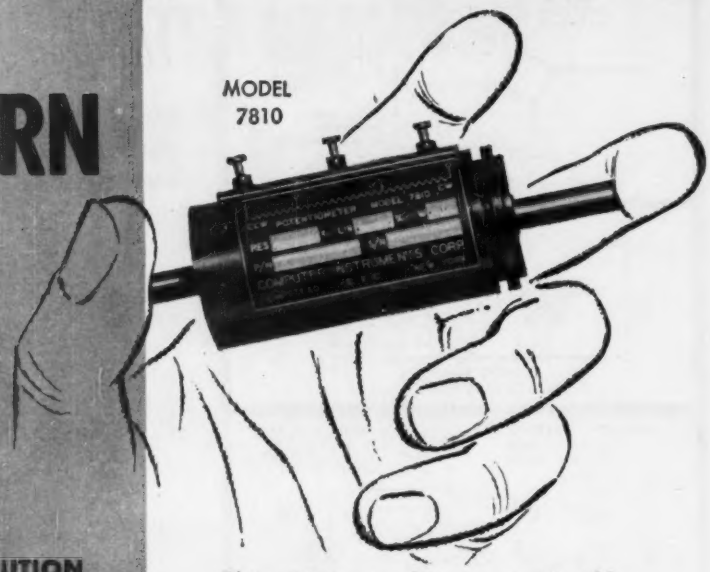

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- **ONE PIECE THROUGH SHAFT**
  Pot fits *anywhere* in your gear train
- **ONE PIECE, ALL METAL CASE**
  Machined-In, Stay-Put Accuracy

This miniature multi-turn precision film pot is not just better than wire-wound types—it brings a new dimension of performance and flexibility to your system. With SuperCon Film pots you can forget about the obsolete concepts of wire resolution, clumsy tapping and shunting to produce non-linear outputs, bulkiness in ganging, and loose-wire, glued-assembly construction. The ball-bearing supported, one-piece through shaft permits you to locate your pot *anywhere* in the gear train, freeing you to select the optimum ratios with the minimum components, to transmit torque through the pot, to miniaturize even more. SuperCon Film pots have the inherent accuracy and reliability to easily meet your requirements.

CIC is the largest manufacturer of Precision Film Potentiometers, having pioneered in their development, with a 10-year record of supply to all branches of the Armed Services and throughout industry. Our staff of technical specialists is ready to assist you with your potentiometer needs.

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CIRCLE NO. 93 READER SERVICE CARD→

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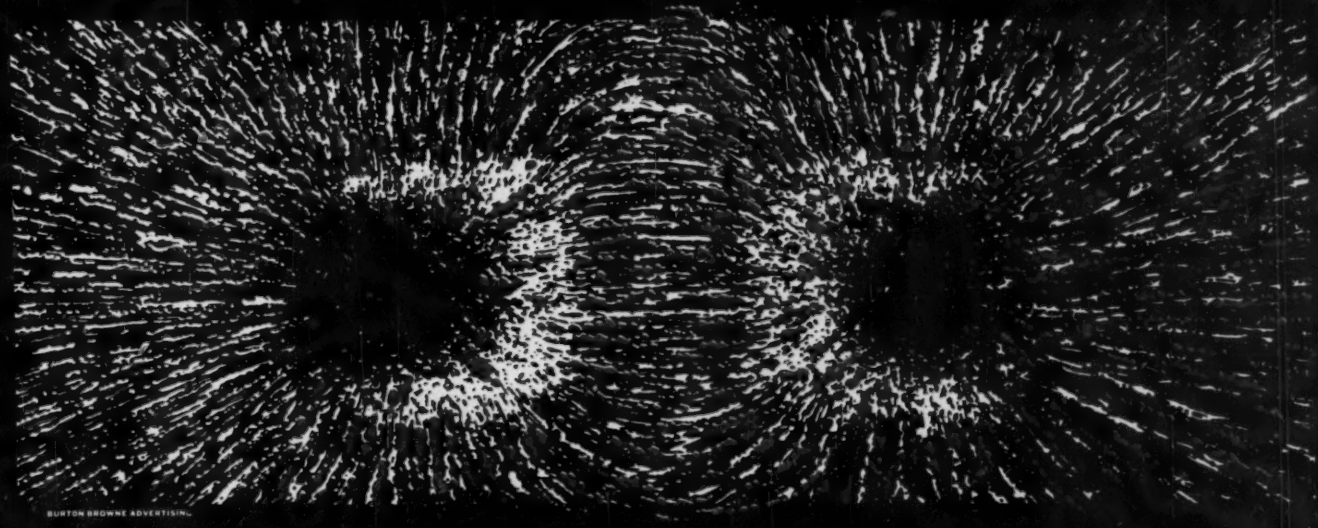

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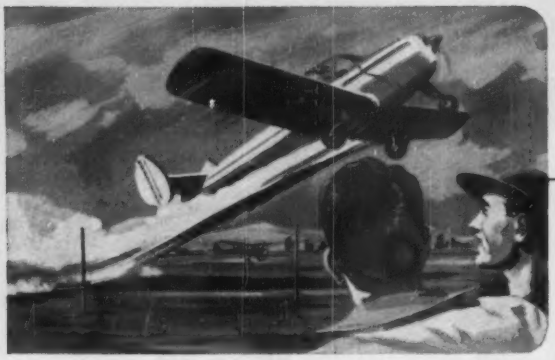

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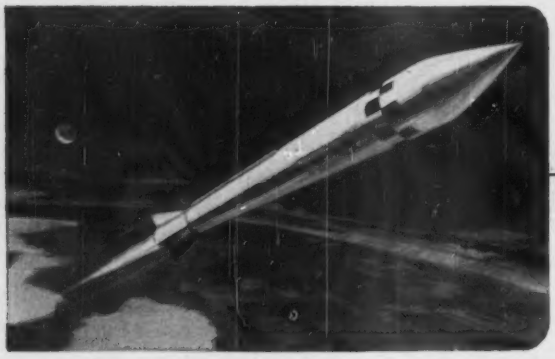
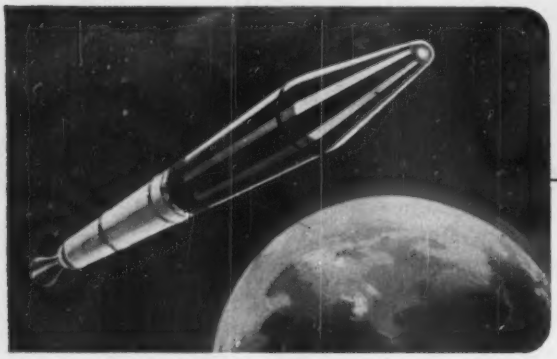


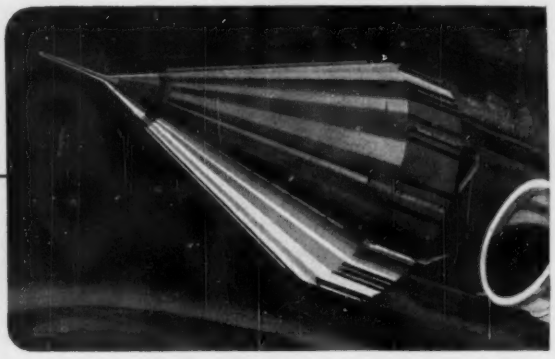
THE CORPORAL... this country's first ballistic surface-to-surface guided missile, now an operational weapon of the U.S. Army, was pioneered and developed by the Jet Propulsion Laboratory.



EXPLORER I... The United States' first successful earth satellite, launched January 31, 1958, was developed by JPL in collaboration with the Army Ballistic Missile Agency.

THE WAC-CORPORAL... fired in flight from a V-2 rocket, established a world's altitude record of 250 miles in 1949. The combination was known as the Bumper-Wac.

THE SERGEANT... A second-generation solid propellant missile developed by JPL for the U.S. Army. The SERGEANT is now being readied for production.



PIONEER IV... America's first successful moon-space probe, launched March 3, 1959, was developed by the Jet Propulsion Laboratory in collaboration with the Army Ballistic Missile Agency and the National Aeronautics and Space Administration.

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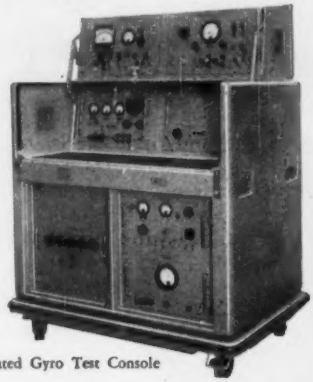
Inertial Guidance System Test Console

IN-PLANT TEST EQUIPMENT: Rack-mounted modules comprise the necessary metering circuits, signal generators and power supplies, switching circuits and junction boxes to perform the following tests on inertial reference systems:

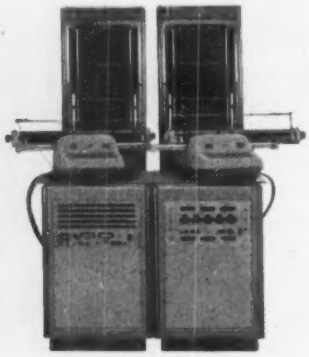
Voltage and phase • Current • Heating cycle checks • Verticality of platform in ground erection mode • First order erection time in ground erection mode • Measurements of platform roll and pitch output angles in ground erection mode • Measurements of free drift of platform in azimuth in ground erection mode • Measurement of azimuth gyro torquer scale factor in ground erection mode

FIELD-TYPE TEST EQUIPMENT: Modularized, self-contained unit that provides all power and signal voltages to operate, test or trouble-shoot a gyro. All inputs to and outputs from the gyro are accessible at convenient jacks where connections to measuring equipment can be made, thereby enabling operator to evaluate gyro performance completely. Modules are slide-mounted for ready access if repair, modification or product improvement replacement are required. This portable equipment performs these basic tests:

Insulation resistance • Warm-up time • Torquer scale factor measurement Gyro transfer function • Free drift • Gimbal offset drift • Continuity Signal Generator Null • Phasing • Gyro drift • Fixed torque restraint



Floated Gyro Test Console



Scanalog 200-Scan
Alarm Logging System

GENERAL PURPOSE DATA PROCESSING: This data handling system provides a reliable, precise means of monitoring, logging and performing an alarm function of up to 200 separate temperature, pressure, liquid level or flow transmitters. Manual controls are provided for scanning rates, automatic or manual logging, data input relating to operator, time, day, run number and type of run. 200 numbered lights, corresponding to specific points being maintained, provide a visual "off normal" display for operator's warning. This system has growth built in and can be expanded in capacity to 1024 points and in scanning rate to 2000 points per second.

Write for complete information on Kearfott's ground support equipment.

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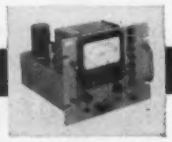
VTVM-PSVM

High-Speed
Precise Angle
Indicator Module



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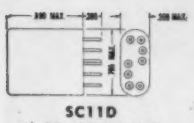
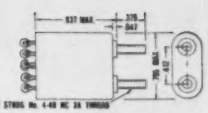
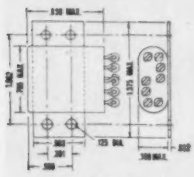


SC11D
6, 12, 24, 36 Volts



SC11DK
6, 12, 24, 36 Volts



SC11DB
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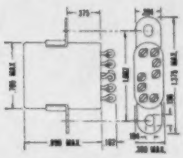

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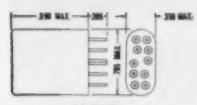

SL11D
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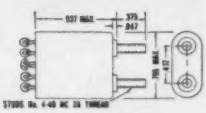
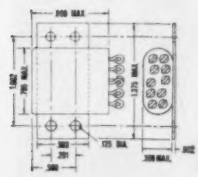
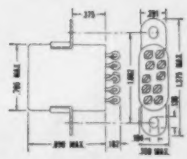


SL11DK
6, 12, 24, 36 Volts



SL11DB
6, 12, 24, 36 Volts



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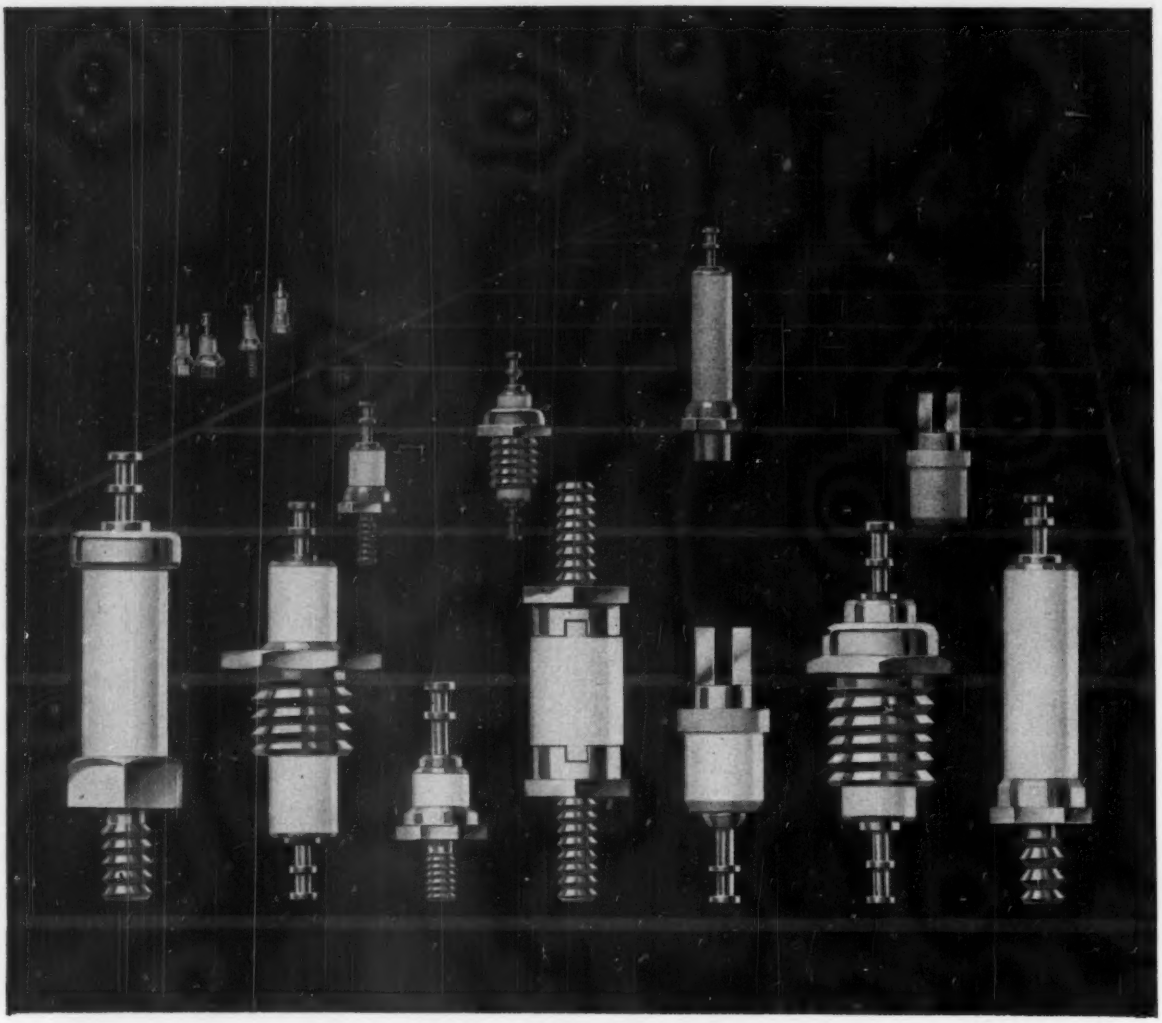

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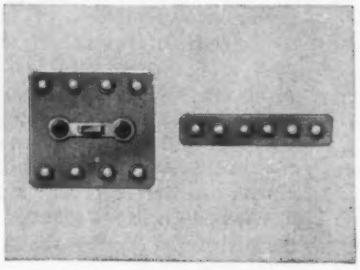

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	2N1219	2N1220	2N1221	2N1222	2N1223
V_{CBO}	30 v	30 v	30 v	30 v	40 v
V_{CEO}	25 v	25 v	25 v	25 v	40 v
V_{EBO}	20 v	20 v	10 v	10 v	10 v
I_{CO}	.1 μa max.	.1 μa max.	.1 μa max.	.1 μa max.	.1 μa max.
h_{FE}	18 min.	9 min.	—	—	—
f_{ab}(mc)	5 min.	2 min.	5 min.	2 min.	2 typ.
h_{fe}	—	—	18 min.	9 min.	6 min.

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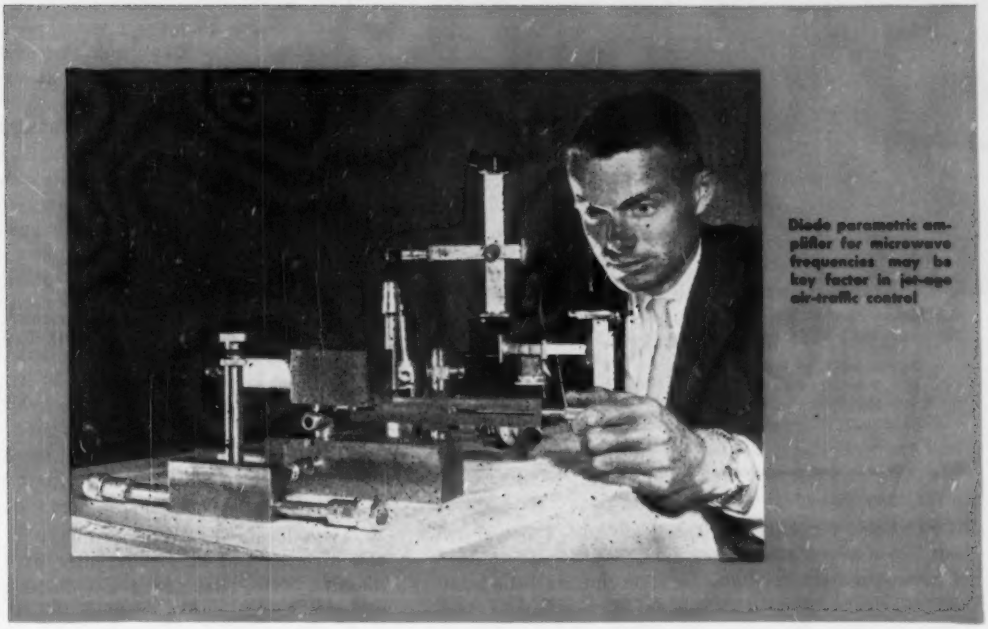


Diode parametric amplifier for microwave frequencies may be key factor in jet-age air-traffic control

Technical and Business Growth in the West

Eleven western states expect nearly $2 billion sales for 1959, with airframe makers swinging more to electronics. New technical developments include field-emission cathode, electron-beam and diode mavars and plasma amplifier

By **HAROLD C. HOOD,** Pacific Coast Editor

SAN FRANCISCO—THE RECENT CHANGE IN NAME from West Coast Electronic Manufacturers Association to Western Electronic Manufacturers Association reflects a trend in the development of electronics in the West. Ten years ago almost 100 percent of the area's $158 million sales was chalked up by the four coastal centers encompassing Los Angeles, the San Francisco Bay area, Portland and Seattle, and San Diego. Today, industry mushrooming around Denver, Phoenix, Tucson, and Sacramento, and dozens of smaller centers contributes appreciably to the $1.932 billion eleven Western states sales total projected for 1959. See Fig. 1, p 104.

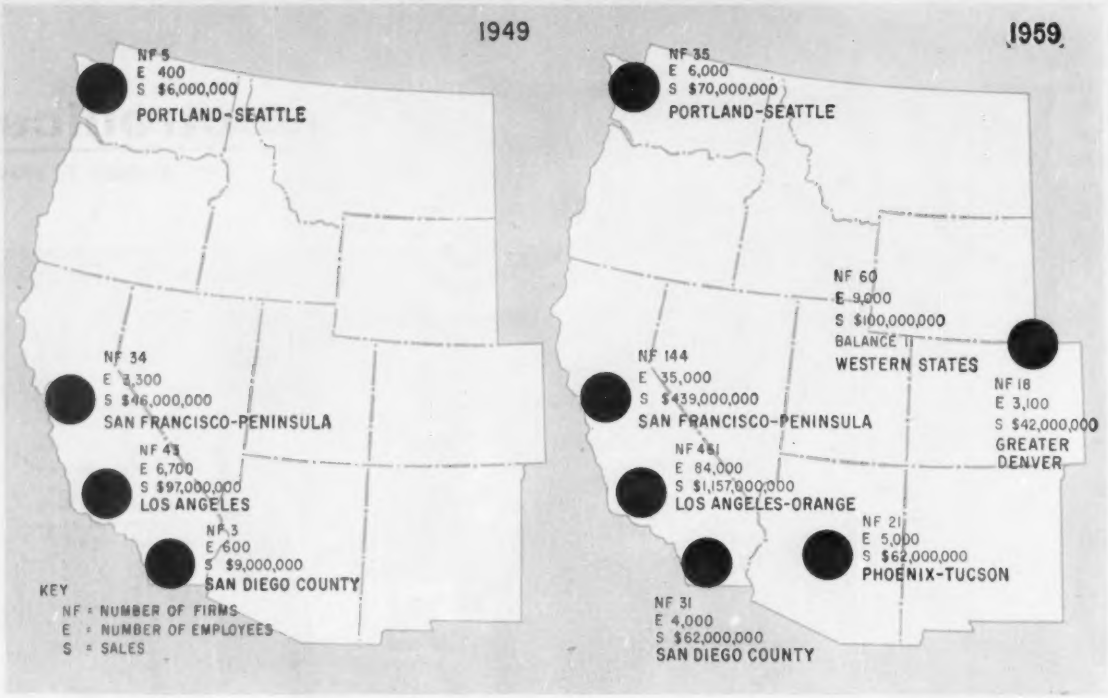


FIG. 1—Growth and geographical distribution of electronics industry in eleven western states

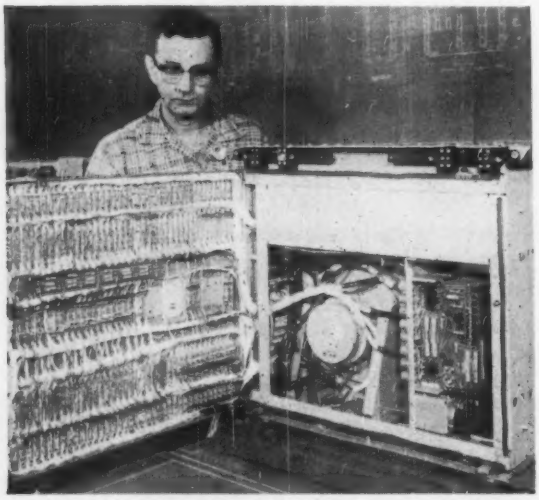
BUSINESS FIGURES—Statistics for 1958 show that 735 western electronics firms had a sales volume of approximately $1.794 billion (excluding broadcast and service revenue) or about 23 percent of the nation's total. Recent surveys show employment figures at 140,000 or 19 percent of the industry total.

Last minute indications (Fig. 2) point to an attendance of 30,000 plus at the Western Electronics Show and Convention (WESCON) this month, or up 20 percent from the last time San Francisco hosted the convention (1957). More than 700 organizations will display wares and latest developments in nearly 1,000 booths in San Francisco's Cow Palace.

AIRFRAME MAKERS—The Los Angeles Chamber says its local electronics industry is closing in on the aircraft industry, currently at the top of the manufacturing list for gross dollar volume, and is expected to pull out in front in the near future.

However, many aircraft manufacturers some time ago established electronics capabilities in the process of diversifying to missile manufacture. Only 10 percent of today's missile dollar goes for airframe, and a sizable amount of the remainder goes for electronics.

Today, the airplane people are producing and tooling up for electronic gear aimed at the industrial, commercial, and consumer markets as well.



General-purpose digital computer Recomp II will compute reliability factor in flight of space vehicle at '59 Wescon

FIELD-EMISSION CATHODE — At Linfield Research Institute, East of Portland, a promising development centers about a field-emission cathode. Utilizing an energized field and a sharply pointed cathode from which electrons are pulled, the device requires no cathode heating. Electrons stream off the point without damaging it. The sharper the point, the easier the electrons are pulled off.

With relatively low voltages, a good emission of electrons may be obtained. Future applications include a cathode-ray tube in which it is desired to get extremely fine writing on the surface of the tube. Since electrons come from a fine point source, it is easy to refocus the beam later on.

Reportedly, the device might also be used in linear accelerators. By injecting the cathode directly into the waveguide, it is conceivable that the voltage of the wave itself will draw the electrons from the cathode. The field emission cathode's characteristics make possible its use in voltage regulator applications.

MAVARS—Another recent development, from Zenith's facility south of San Francisco, a low-noise parametric amplifier or mavar, is currently in pro-

duction. The tube operates at room temperature, has only one db of noise at 70 F. It has particularly promising applications in radio astronomy, and eliminates the need for cooling equipment at the beam focus.

Hughes Aircraft has recently developed a microwave parametric amplifier reportedly capable of increasing radar range as much as 100 percent.

Approximately 8 in. long, 6 in. high and 1 in. wide, the amplifier utilizes a small crystal of germanium or silicon. There is no hot cathode or noisy electronic stream which adds limiting noise in many amplifiers now used on radar signals.

This device reportedly makes possible the improvement in noise figure by 3 to 8 db over the best superheterodyne receivers. No large external auxiliary equipment is required. Low noise amplification is obtained without cooling to liquid-helium temperatures.

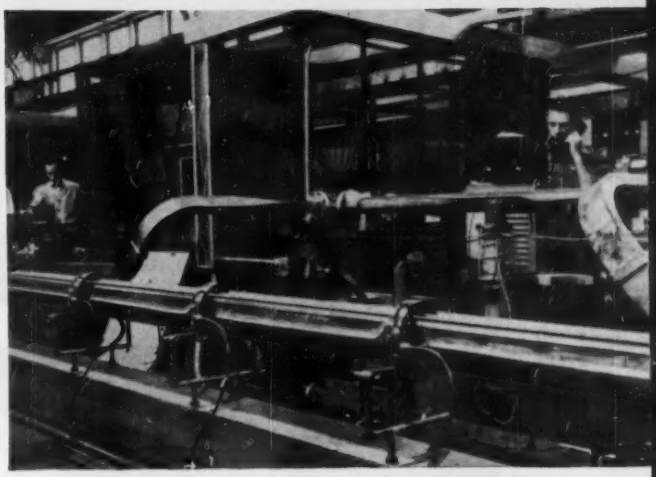
Heart of the device is a gold-bonded diode with noise temperature of 100 K obtained at room temperature. A 3,000-mc amplifier gives 30 db of amplification with 2-mc bandwidth, or 10 db of amplification with 25-mc bandwidth. The amplifier has a nominal cutoff frequency of 70,000 mc at maximum back bias with a nominal zero bias capacitance of 2.5 $\mu\mu$f.

SUN BOTTLE—An example of developments stemming from academic research is the recently announced sun bottle at Pasadena's CalTech.

By introducing mercury gas into a vacuum tube, and then passing an electric current through it, researchers were able to form a plasma—the so-called fourth state of matter—similar to the sun's corona. (A plasma is formed when the temperature of a gas is raised to the point at which its atoms start to disintegrate.)

As electron beams were shot through the plasma, it jiggled with jelly-like oscillations. "This apparently is one of nature's ways of amplifying radio signals powerful enough to carry across millions of miles of space," theorizes an Institute scientist. "In addition to the sun, some of the other so-called radio stars in space may use this mechanism."

CalTech scientists feel that their development may provide a useful tool for the plasma studies involved in developing nuclear fusion power. They also see possibilities of the finding leading to amplifiers and oscillators of higher radio frequencies than now possible—frequencies between the microwave and infrared range—thus opening up possible new radio communication bands.



Two-mile-long traveling-wave electron accelerator will replace this 310-ft one-billion electron-volt machine. New machine will eventually produce 45 bev energy

TRAVELING-WAVE ACCELERATOR — Another research project is the two-mile long linear accelerator to be constructed at Stanford University over the next six years. The approximate cost will be $100 million.

Two parallel tunnels—one 15 ft in diameter and housing the accelerator tube, the other 25 ft across and containing 240 giant klystrons used for electron acceleration—will bore 35 ft beneath the university campus. The machine initially will be capable of producing 10 billion electron volts, eventually 45 billion. Proposed beam power will exceed a million watts.

To date, the largest Stanford machine (Mark III) is 310 ft long, generates 1 billion electron volts. The two-mile behemoth will be the equivalent of thirty Mark III's laid end to end.

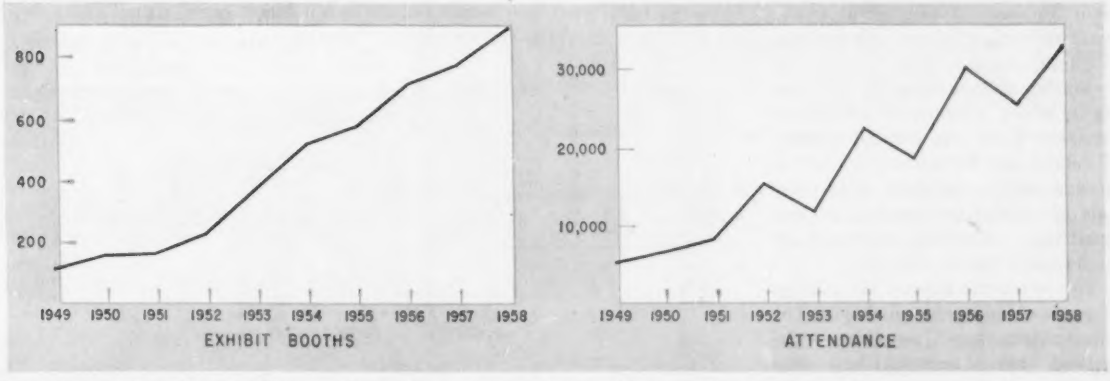


FIG. 2—Increase in number of exhibitors and attendance at Wescon (Western Electronic Show and Convention)

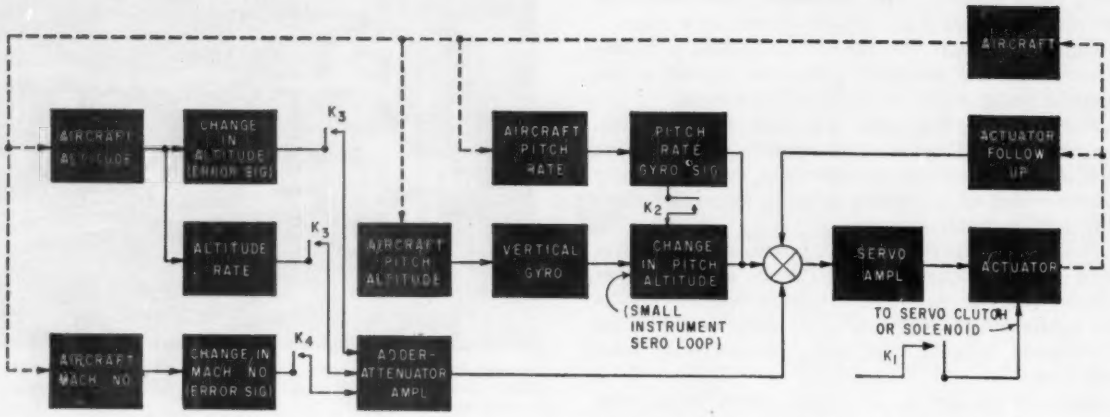


FIG. 1—Pitch channel of flight control system with three operating modes. Relay K_1 energizes the channel and provides pitch rate damping; K_2 gives attitude, K_3 and K_5 gives altitude, K_3 and K_4 gives mach mode

Taking the Bumps Out of

Bumpless flight control changes for high speed jets are possible with special amplifier. Circuit fades out existing errors slowly, brings in new control mode without transients

By L. D. FRY, Flight Control Engineer, LMED, General Electric Company, Johnson City, New York

THE PILOT OF A HIGH SPEED JET has several flight control modes available such as mach control, altitude control or attitude control. When a change is made from one mode to another, undesirable aircraft motion, or bumps, can develop.

These bumps are caused by switching transients or by an error signal which is suddenly put into or removed from the control system. If relays and switches are used to change modes, existing error signals are added or removed as step functions. Aircraft response to such inputs can be violent.

To reduce the bumps, the change of mode should be done slowly. The adder-attenuator amplifier described here accomplishes this function. It is being used on the Navy's first supersonic two-seated all weather jet fighter, the F4H-1.

Flight Control System

In a flight control system several error signals feed each servo loop. In the pitch channel, for example, there may be a rate gyro signal to reduce pitching, a vertical gyro signal for holding a selected pitch angle or attitude, an altitude error and rate signal for altitude control, and a mach error signal for speed control.

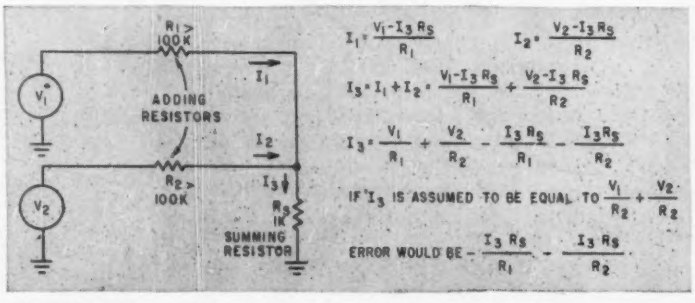
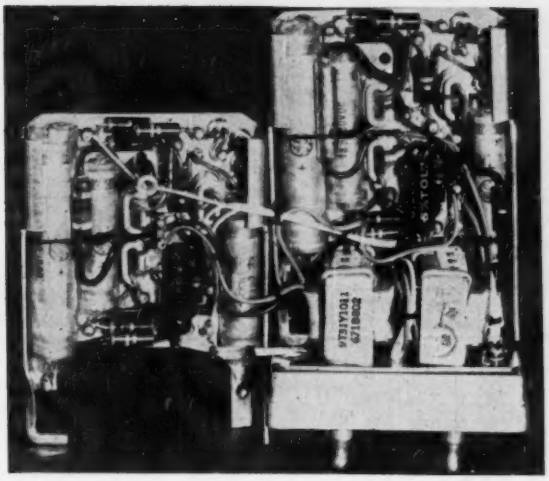
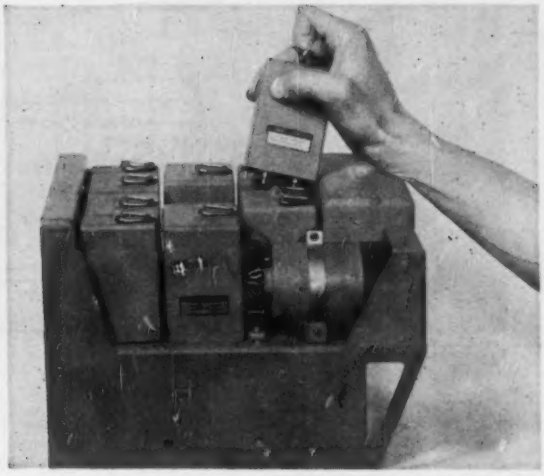

R1 > 100K
ADDING RESISTORS
R2 > 100K
R3 1K SUMMING RESISTOR
V1
V2
I1
I2
I3
$I_1 = \frac{V_1 - I_3 R_3}{R_1}$
$I_2 = \frac{V_2 - I_3 R_3}{R_2}$
$I_3 = I_1 + I_2 = \frac{V_1 - I_3 R_3}{R_1} + \frac{V_2 - I_3 R_3}{R_2}$
$I_3 = \frac{V_1}{R_1} + \frac{V_2}{R_2} - \frac{I_3 R_3}{R_1} - \frac{I_3 R_3}{R_2}$
IF I_3 IS ASSUMED TO BE EQUAL TO $\frac{V_1}{R_2} + \frac{V_2}{R_2}$
ERROR WOULD BE $-\frac{I_3 R_3}{R_1} - \frac{I_3 R_3}{R_2}$

FIG. 2—Adder circuit. With values shown, error is less than one percent



Smoothing unit package is filled with dry nitrogen and hermetically sealed



Plug-in construction and finger pull ring make for ease of maintenance

Automatic Flight Control

Figure 1 shows a possible pitch channel with operating modes of mach, altitude, and pitch control. Relays are used to select the required error signals for each mode. Not all error signals are desired at the same time or all the time.

Relay K_1 changes the pitch channel from standby to the stability augmentation mode by connecting the actuator to the aircraft control surfaces. With K_1 closed, and the other relays open, the pitch channel operates on signals from the pitch rate gyro to dampen pitch angular motion. Closing K_2 energizes the attitude control mode; K_2 and K_3 together give the altitude mode; K_2 and K_4 the mach mode. With the adder-attenuator in the circuit as shown, changes in mode are made smoothly.

Adder Circuit

The main function of the adder-attenuator amplifier is to decrease the gain slowly, allowing the new control mode to be set up, and then bringing the gain back to normal. Four circuits are used: adder, amplifier, fading and relay.

The purpose of the adder section is to add or mix the incoming error signals. The method used is conventional and is shown in Fig. 2. The adding resistors are kept greater than 100,000 ohms while the summing resistor is less than 1,000 ohms. Error in addition under these conditions is less than one percent. Isolation of signal sources is obtained and little interaction results. Gain loss in the adder circuit is made up in the amplifier which follows.

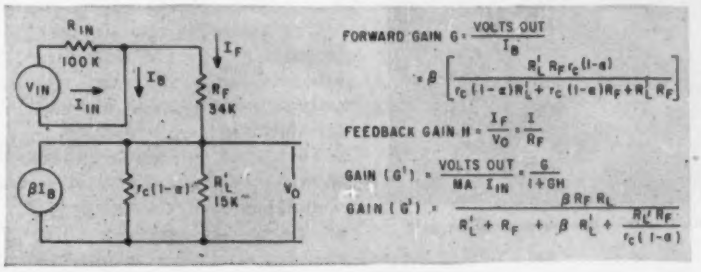


FIG. 3—Amplifier equivalent circuit and gain equations

The adder-attenuator amplifier drives two servo amplifiers, although only one is indicated in the figures. The input circuit of the servo amplifiers is the same as the input adder circuit of the adder-attenuator amplifier which drives it. Since additional gain is not required, the smoothing unit must deliver to each servo the same current it receives. Because two servos are supplied, current gain is 2 ma/ma. Desired voltage gain is 0.3 volt/volt. The equivalent circuit and equations are shown in Fig. 3.

The circuit of the adder-attenuator amplifier is shown in Fig. 4, with the amplifier section so indicated. Actually, the complete unit

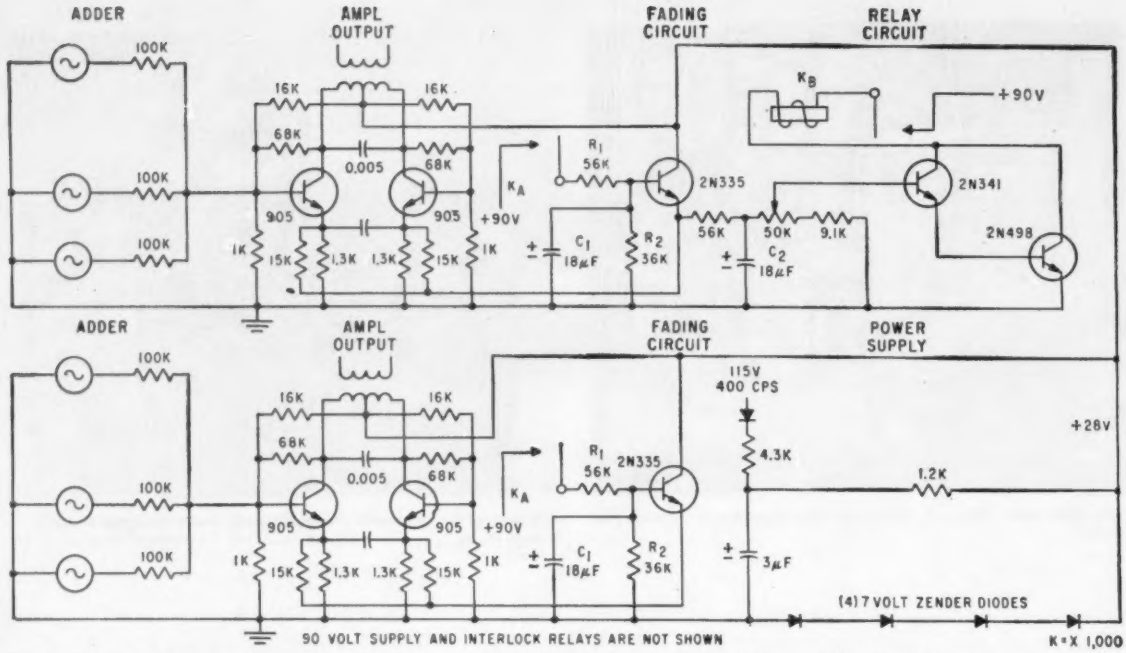


FIG. 4—Fading circuit decreases amplifier gain slowly so changes in control mode can be made smoothly. Relay K_B allows new mode to be set up and output then increases to normal

includes circuits for two control channels but operation is the same in each channel. Only one relay section is needed for the two channels.

When a step-function d-c voltage is applied to a single transistor fade circuit, a transient response is transmitted through to the collector circuit and into the amplifier. A balanced difference amplifier is used

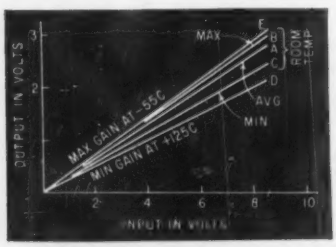


FIG. 5—Adder-attenuator amplifier gain

to prevent this transient bump. With both transistors being driven in the same manner, any transient that appears on one collector will also appear on the other. Only the difference is transmitted through to the servos.

Gain Variations

Production tolerance silicon transistors are used throughout and parameters β (grounded-emitter short-circuit current gain) and r_c (collector resistance) vary greatly from transistor to transistor. Examples are:

	β	$r_c(1-\alpha)$	Amplifier Voltage Gain
Min.	39	High	0.283 v/v
Nominal	50	50,000 ohms	0.311 v/v
Max.	120	25,000 ohms	0.330 v/v

The variation in gain does not include the effect of resistance or other changes. Only the approximate equivalent circuit was used for calculations.

Test results on ten amplifiers are shown in Fig. 5. Curve *A* is the nominal gain of the ten amplifiers at room temperature; curve *B* shows maximum gain observed at room temperature and curve *C* the minimum. The spread from minimum to maximum is 0.288 to 0.346 volt/volt, with a nominal gain of 0.332 volt/volt.

At −55C the maximum gain is 0.363 v/v, curve *E*, and the minimum gain is 0.25 at +125 C, curve *D*. Resistance changes in the feedback resistors and variations in β and r_c with temperature are probably the main causes of gain variation.

Fading Circuit

The function of the fading circuit is to decrease the output of the amplifier during the mode changing operation. After the new control

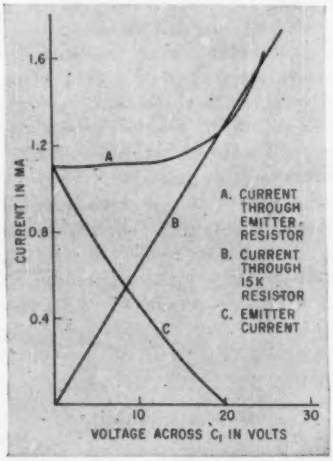

CURRENT IN MA
VOLTAGE ACROSS C_1 IN VOLTS
A. CURRENT THROUGH EMITTER RESISTOR
B. CURRENT THROUGH 15K RESISTOR
C. EMITTER CURRENT

FIG. 6—Amplifier emitter current falls to zero as fade current rises. Emitter to base junction is eventually back-biased

mode has been set up by relay circuits, the fading circuit brings the amplifier back up to full output.

This control action is accomplished by varying the emitter-to-base bias of the amplifier transistors.

The fading circuit is included in Fig. 4. In the regular operation of a channel, the voltage on C_1 and C_2 is zero.

Table 1—Circuit Characteristics With 100,000-Ohm Input Adding Resistors

Gain at room temp.	0.33 ± 0.03 v/v
Gain at −55 C	0.33 ± 0.05 v/v
Gain at 125 C	0.29 ± 0.045 v/v
Time constant	0.25 to 0.75 sec
Saturation voltage	30 volts or more
Output null	0.040 volts max
Relay operate time	1.5 times max time constant plus 0.15 sec
Deadband	0.3 sec or less
Power supply	108 to 123 v, 380 to 420 cps
Vibration	10 g
Gain ratio, faded out to faded in	1/100

When the pilot operates the fading switch (not shown) relay contact K_4 closes and 90 volts d-c is applied to the fading circuit via the network in the transistor base circuit. Capacitor C_1 begins to charge.

The fading circuit transistor begins to conduct and a positive voltage is slowly applied to the amplifier emitters through the 15-k resistors. This control voltage reduces the amplifier gain.

Eventually the amplifier is back-biased and cut off completely. When the fade command is removed, C_1 discharges and amplifier gain increases to normal again.

Currents in the amplifier emitter circuit are shown in Fig. 6. Current through the emitter resistor is the sum of emitter current and fade current. This current remains relatively constant until no current flows through the transistor and it is cut off. As the voltage from the fade circuit continues to rise, the amplifier transistors become back-biased.

Deadband Effect

The amplifier output does not begin to increase immediately when the fade command is removed. This deadband effect results from the reverse bias developed at the emitter-to-base junction during the faded out period. The time lapse (deadband) before the amplifier begins to function is dependent on transistor characteristics and temperature.

This deadband effect and the fade in and fade out time constants are shown in Fig. 7 for two temperatures. Fade out time constant is defined as the time required for output to fall to 37 percent; for fade in, the time to rise to 63 percent of output.

Fade in and fade out time constants are not equal. During fade out, voltage across C_1 (Fig. 4) rises as a function of time constant $C_1 R_1 R_2/(R_1 + R_2)$. During fade in it falls as a function of $R_2 C_1$. The actual fade in and fade out time constants of the circuit are dependent on temperature and also on the non-linear relation of amplifier gain versus emitter current.

From Fig. 7, fade out time constant at high temperature is 0.5 seconds and fade in time constant is approximately 0.3 seconds.

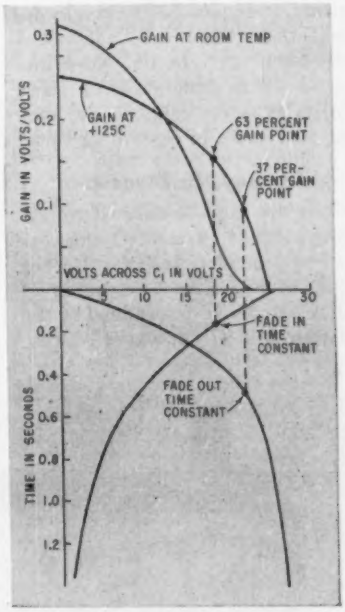


FIG. 7—Amplifier gain drops off as voltage across fade capacitor rises. Time constants at 125 C are indicated

The time constants at room temperature and at low temperature are not indicated in Fig. 7 but it can be seen they will have values

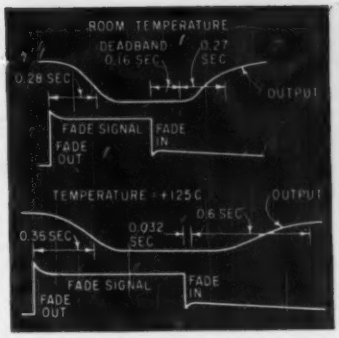


FIG. 8—Smoothing unit response at two temperatures, showing deadband effect

slightly different from the values at 125 C. This difference is not significant in the application and is caused by variations in gain and in the way the time constants are defined. The range of variation is given in Table I.

Relay Circuit

During the fade sequence the error signals into the adder are changed. The point selected for this operation is when the amplifier gain has dropped to 10 percent or less of normal output. The circuit is included in Fig. 4. As the voltage across C_2 rises, the transistors begin to conduct and relay K_2 pulls in. This relay provides the interlock for changing the flight control mode.

A potentiometer allows the operating point to be adjusted as required. When the fade command is removed, the voltage on C_2 decreases and the relay drops out. The drop out point is reached before amplifier gain is up to 10 percent of full output.

The response of the smoothing unit to a fade signal is shown in Fig. 8.

Operation

Control of the fade in, fade out sequence is at the command of the pilot. He operates the switch which applies 90 volts d-c to the fading circuit. The amplifier gain begins to fall off. When it reaches 10 percent, the interlock relay pulls in and the new control mode is set up. The pilot then removes the fade command and the amplifier gain increases to normal again.

Amplifier characteristics are shown in Table I.

Many transistorized circuits can be adapted to construction from a single wafer of semiconductor material. Possible interactions between components can be utilized to design new devices and circuits. Limitations of components and circuits are covered along with their forming methods

By JACK S. KILBY, Senior Project Engineer, Texas Instruments, Inc.; Dallas, Texas

Semiconductor

SEMICONDUCTOR SOLID CIRCUITS are electronic devices formed on single-crystal semiconductor wafers, each of which can perform the function of some standard circuit that uses several conventional elements. Paths are fashioned on and through each wafer to produce active elements such as transistors, nonlinear elements such as diodes, and passive elements such as resistors and capacitors. By changing the types of paths and their routes, an unlimited variety of circuits may be formed. These circuits enable a great reduction in equipment size and weight.

Though it has always been possible to design a configuration that will perform the desired circuit functions, it has not always been possible to provide the required component values within the allotted space. For example, the circuit configuration for a conventional grounded-emitter audio amplifier can easily be drawn. However, such amplifiers require capacitors with values in the microfarad range for coupling and bypassing, which would require many square inches of semiconductor surface.

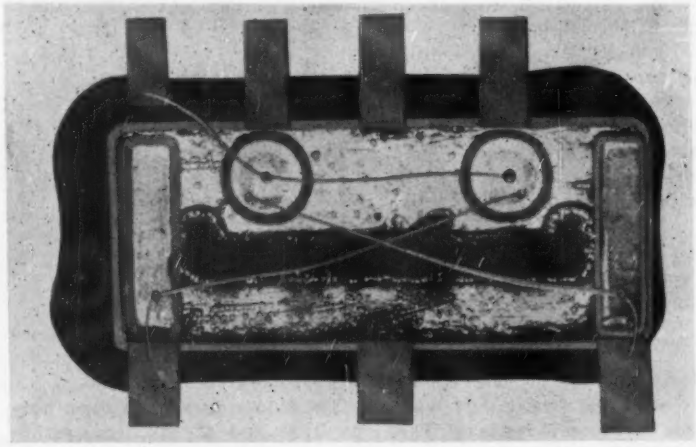
The values of resistors and capacitors are restricted by the intended degree of miniaturization. For high component densities, it is desirable to limit resistors to about 20,000 ohms or less, and to limit capacitors to about 3,000 $\mu\mu$f—depending on the size objectives for the equipment and the space required for other circuit components. A single resistor higher than 20,000 ohms might be permissible, while four or five 20,000-ohm resistors might not.

The microminiature size of these devices makes it difficult to distinguish alternate current paths and to identify all of the individual circuit elements in one device. Also, with the possibility of interaction between distributed-constant components, it is possible to create devices that have no equivalent lumped-constant circuit. Nevertheless, to aid in understanding these circuits it is desirable to use conventional terms in describing them.

Forming the Elements

Resistors may be formed by applying ohmic or non-rectifying contacts to a semiconductor wafer as shown in Fig. 1A. The values of such resistors are determined by the equation $R = \rho L/A$, where ρ is the resistivity of the material, L the length, and A the cross-sectional area of the path. Since the electrical properties are determined primarily by the nature of the bulk material, these resistors will have low noise characteristics, good linearity, somewhat high temperature coefficients, and good stability with time. If two or more resistors are to be connected together it is not necessary to provide separate terminations from the common point.

Capacitors may be formed by using the capacitance of a back-biased p-n junction as shown in Fig. 1B. These capacitors are also diodes, and must be properly polarized in the circuit. Nonpolar capacitors may be produced by connecting two p-n junctions back-to-back. Junction capacitors have a marked voltage dependence, the ca-



Magnified view of complete bistable multivibrator unit, which will be only 0.24 by 0.12 by 0.25 in. after hermetically sealing

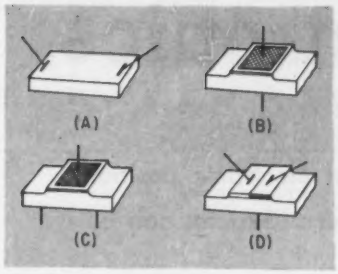


FIG. 1—Resistors (A), capacitors (B), RC networks (C) and transistors (D) can all be formed on same piece of semiconductor

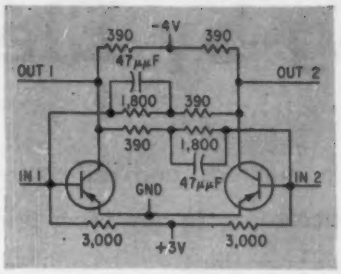


FIG. 2—Bistable multivibrator is typical of conventional circuits that are readily adaptable to solid-circuit techniques

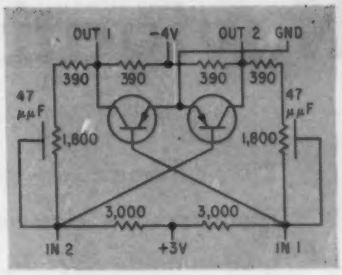


FIG. 3—Redrawn version of circuit of Fig. 2 shows approximate layout arrangement of actual semiconductor solid circuit

Solid Circuits

pacitance of those produced by diffusion techniques being inversely proportional to the cube root of the applied voltage. This voltage dependence is reduced for the nonpolar configuration, but must still be considered in circuit design. For junctions with low breakdown voltage, capacitances up to 200,000 $\mu\mu f$/sq in. are realizable. Capacitors which will withstand several hundred volts may also be formed. Junction capacitors have little variation with temperature and good stability with respect to time.

R-C Network

Resistor and capacitor elements may be combined to form the distributed-constant R-C network shown in Fig. 1C. These infinite section R-C filters are useful for phase-shift networks and coupling elements as well as low-pass filters. Because of the layerized nature of the circuits, networks of this type are easily formed.

Transistors and diodes may be formed on a semiconductor wafer by conventional diffusion processes. These processes form the mesa type transistor shown in Fig. 1D. The 2N559, 2N702, 2N705 and 2N1141, recent examples of mesa type transistors, have excellent high-frequency characteristics. Diodes may be formed by using the same diffusion techniques.

Since all of the circuit elements described can be formed from one raw material, they all can be formed on a single wafer. Some passive circuit elements are produced by shaping the wafer to restrict current paths to specific parts of the wafer. Junction areas for transistors, diodes, and capacitors are formed by properly shaped mesas on the wafer. Thus, a given type of diffused wafer may be used to produce many types of circuits, the first difference being the particular shaping processes that are used on each wafer.

Bistable Multivibrator

One example of a semiconductor solid circuit, as shown in Fig. 2, is a bistable multivibrator which contains the equivalent of eight resistors, two capacitors, and two transistors. This device is shown in the photograph. With the circuit of Fig. 2 redrawn as shown in Fig. 3, the resistive areas are around the outside of the wafer; the capacitors and transistors lie on the surface of the resistors. The slot in the center of the wafer provides the necessary isolation between components.

The size of the finished hermetically sealed multivibrator is 0.240 × 0.120 × 0.025 in. Excluding the leads, the volume of the sealed package is 0.0007 cu in.—which provides a density of about 30-million components/cu ft.

This component density cannot be achieved in equipment because the interconnections may occupy more volume than the components. However, if the components and the wiring occupy equal volumes it might be possible to pack a million multivibrators into 1 cu ft—provided power dissipation is ignored. If each device requires 50 mw of power, 50 kw will be dissipated within the cubic foot. Therefore, much of the volume will be required for heat-transfer media even if the power requirements can be greatly reduced.

Applications

Semiconductor solid circuits appear to be especially adaptable to digital circuitry. Digital circuits are usually quite repetitive, permitting the construction of large systems with only a few basic building blocks.

Due to the present limitations on component types and values, considerable ingenuity will be required to adapt these devices to all types of circuits. The lack of large-value capacitors will slow the development of audio-frequency circuits, while the wrist radio is still out of reach because of the inductances required. However, these restrictions are expected to be temporary.

Along with size and weight reductions, these devices should achieve improved reliability. Since each circuit is formed on a single-crystal high-purity semiconductor wafer, there is a reduced number of contacts between dissimilar materials, which should raise the inherent reliability. There are numerous stages during assembly where accurate process controls can be applied and thereby tighten the standards for quality control. Finally, the significant reduction in size and weight means that designers can re-evaluate alternate circuit schemes such as the use of more redundancy that heretofore were not considered because the available space was inadequate.

Navigating by Electronics

Classical radio navigation methods and self-contained electronic position computers are classified according to operating principles. Systems can be used to guide aircraft, missiles or ships

By P. C. SANDRETTO,

Vice-president and Technical Director, ITT Laboratories Division, International Telephone and Telegraph Corp., Nutley, N. J.

RADIO NAVIGATION METHODS which establish transmission paths and observe transmission times are classical systems. One form, the multiple path system, originated before 1903 with the Hertzian lighthouses. More recent refinements in the observation of natural phenomena have resulted in self-contained position computers.

CLASSICAL SYSTEMS—In the multipath method (Fig. 1), radiation is sent over two paths to two collectors. The collectors may be sides of a loop antenna, two dipoles or two incremental areas of a parabolic radar antenna. Another form has multiradiators and a single collector. Several phase coherent transmitters may be used. Either form usually requires only a single receiver to actuate the phase (time difference) detector.

Multipath systems produce lines of position which are hyperbolas. True hyperbolic systems have antennas spaced wide in comparison to wavelength. They measure the actual difference in transmission delay over the several paths. Radial systems employ small spacing and have hyperbolas of zero curvature. They usually determine the condition for equal transmission delay over the multipaths.

The best known multipath systems are named below Fig. 1 in order of intrinsic accuracy. Approximate values are given. Accuracy is also affected by frequency propagation characteristics and instrumentation. Neglecting propagation effects, accuracies range from 10 degrees to 0.01 degrees for non-free-space conditions.

Single path systems measure actual transmission times and produce circular lines of position. There are two types, described as one way and round trip.

One way systems (Fig. 2) have had relatively little use. They require an oscillator in the vehicle locked in phase with an oscillator at the transmitter. Accurate navigation requires an oscillator accuracy better than one part in 10^9. One way systems provide distance in Navarho and, partly, in Dectra. Development of lightweight atomic oscillators may give them greater commercial success.

Round trip systems (Fig. 3) transmit to active or passive reflectors and receive back a signal which is compared with the original transmission. Compared with one way systems, stability requirements are a million times less. This method is used in radar, Shoran, Oboe, Benito, Rebecca-Eureka, DME and the distance portion of Condar, Tacan, and ATC beacon system. Accuracies to 10 ft. have been attained.

SELF-CONTAINED SYSTEMS — Self-contained systems are classified according to the natural phenomena that they observe. The observation is generally used to compute a present position by extending a known past position.

The atmosphere pressure system (Fig. 4) makes use of the fact that barometric pressure differences indicate wind speed and direction. Two sets of barometric and radio altimeter readings are compared to obtain vector normal wind. The ground speed vector is then computed for dead reckoning navigation. A 10-foot error in successive readings will produce a two-mile error in wind value.

Astro or star tracking systems are a refinement of the ancient astronomical system. Electronic equipment is employed to automatically track or detect radio or visual signals from celestial bodies and solve the astronomical triangle (Fig. 5). Astro system accuracies are not available, but accuracies of improved sextants are indicative. With automatic averaging, 50 percent of measurements are within two minutes and 90 percent within 4.3 minutes.

Doppler shift of a transmitted radio wave (Fig. 6) is used to determine the true ground speed vector. New developments use several pencil beams positioned by servo mechanisms. System accuracy of 0.7 to two percent of the distance travelled are obtained.

Inertial systems observe forces in inertial space. A force acting on a mass is doubly integrated to give the distance traveled. Great precision is required in the gyroscopes orienting the accelerometers. Schuler tuning is employed to make gravity-induced errors cyclical instead of cumulative. Target accuracy is one mile of error per hour flown.

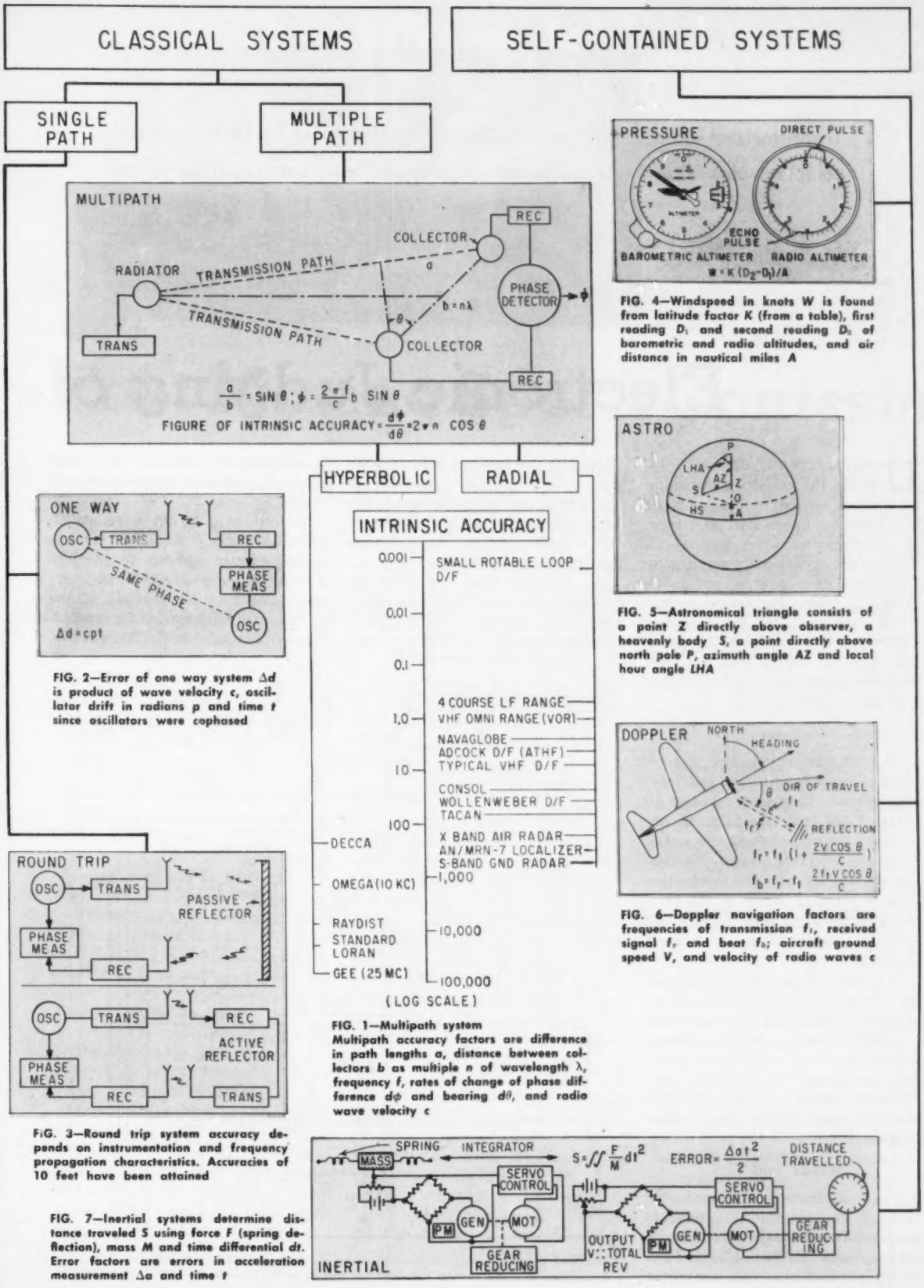


FIG. 1—Multipath system
Multipath accuracy factors are difference in path lengths *a*, distance between collectors *b* as multiple *n* of wavelength λ, frequency *f*, rates of change of phase difference *dφ* and bearing *dθ*, and radio wave velocity *c*

FIG. 2—Error of one way system *Δd* is product of wave velocity *c*, oscillator drift in radians *p* and time *t* since oscillators were cophased

FIG. 3—Round trip system accuracy depends on instrumentation and frequency propagation characteristics. Accuracies of 10 feet have been attained

FIG. 4—Windspeed in knots *W* is found from latitude factor *K* (from a table), first reading D_1 and second reading D_2 of barometric and radio altitudes, and air distance in nautical miles *A*

FIG. 5—Astronomical triangle consists of a point *Z* directly above observer, a heavenly body *S*, a point directly above north pole *P*, azimuth angle *AZ* and local hour angle *LHA*

FIG. 6—Doppler navigation factors are frequencies of transmission f_t, received signal f_r and beat f_b; aircraft ground speed *V*, and velocity of radio waves *c*

FIG. 7—Inertial systems determine distance traveled *S* using force *F* (spring deflection), mass *M* and time differential *dt*. Error factors are errors in acceleration measurement *Δa* and time *t*

Transistorized indicator judges foul or fair in the sport of fencing despite complex rules. Can ingenious electronic devices help umpire other sports?

By **W. R. DURRETT**, Project Engineer, Designers for Industry, Inc., Cleveland, Ohio

Electronic Judging of

USING ELECTRICAL devices to indicate the validity and timing of touches scored in the sport of fencing is not uncommon. However, as ordinary indicators use relays, fencers are occasionally shocked by transients developed by collapsing relay-coil fields. The transistorized touch indicator to be described eliminates the possibility of shock and responds well within the fast-response times required to monitor fencing contests.

Rules

The transistor indicator detects touches in either epee or foil fencing contests. In epee, touches on all parts of the body are fair. In foil contests, only touches on the metallic-thread jackets worn by the fencers are scored. The conductive area of a jacket composes the fair-touch region for a foil. When a foil hits an invalid area, a foul is registered.

A touch must be held long enough to score a point. With either weapon, after a touch is held long enough to score a timing interval begins in which the other fencer may also score. At the end of this interval, which is longer for foil than for epee, no further touches may be scored until the next action.

Swords and Tips

The indicator is connected through two lengths of three-conductor cable to a pair of automatic take-up reels. Each reel holds 50 ft of cable which goes to a connector clipped to the fencer's belt. A body cord runs from this connector to contacts at the tip of the sword; for foil contests, the cord also goes to the metallic jacket. Reel tension does not hamper the fencers.

As shown in Fig. 1, an epee has two wires insulated from the sword blade and running down the blade to a tip assembly that acts as a spst, normally-open switch. A touch closes the contacts between the two wires.

A foil has only one wire, which runs to the tip assembly and is connected permanently to the tip. The foil-tip assembly is a spst, normally-closed switch that shorts the wire to the foil blade and guard. A touch opens this short. The metallic

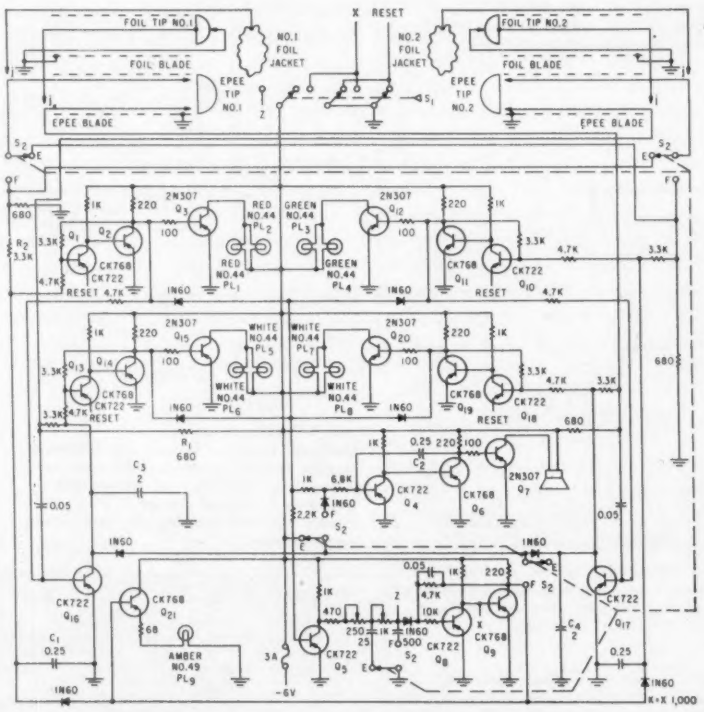
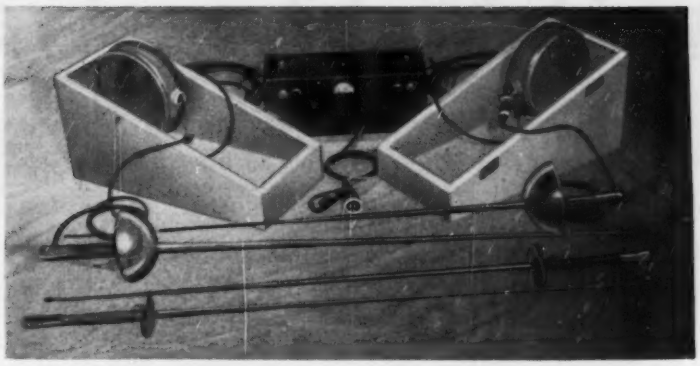


FIG. 1—Transistor fencing indicator is set up for an epee match. For foil, throw switch S_2 to terminal *F* and connect foils and foil jackets to the *j* terminals



Indicator is in center. Reels are connected to epees, which are behind foils

Fast-Moving Sports Contests

jacket is connected to the third wire of the body cord with a detachable clip.

Scoring With Epee

Considering Fig. 1, assume that *epee No.* 2 scores a touch. The tip contacts close, applying a negative voltage to the input of transistor Q_1. Transistors Q_1 and Q_2 form a bistable multivibrator that is called a valid multivibrator. At the start of a fencing action Q_2 conducts, keeping Q_1 and transistor amplifier Q_3 nonconducting. Integrating capacitor C_1 bypasses transients so that the touch must be held until C_1 charges through R_1 and R_2. When the charge level reaches the critical value of about −1.5 v, the multivibrator flops over lighting red-indicating lamps PL_1 and PL_2 and transmitting a signal to Q_4 and Q_5.

Transistor Q_4 is the input transistor of a multivibrator oscillator which drives a 4-in. p-m speaker. Capacitor C_2 provides the feedback path; if C_2 is 0.25 μf, the oscillator tone is about 1,000 cps.

Transistor Q_5 is the input transistor of a timer. With the application of an input signal, the timer input r-c network begins to discharge toward zero v. The timer is set for a given discharge rate. After 0.04 to 0.05 sec the timer flops over, switching on Q_6. This transistor brings the input stages of all lamp circuit inputs to a potential near ground. This action does not affect the red indication but it prevents any subsequent touch by *epee No.* 1 from being scored on the green lights, PL_3 and PL_4. The indicating condition is thus frozen, indicating a touch by *epee No.* 2 and sounding tone until switch S_1 is reset. *Epee No.* 1 scores touches in the same way when it applies a signal to Q_{10}. Transistors Q_{11} and Q_{12} correspond to Q_2 and Q_3.

Scoring With Foil

When fencing with foils, switch S_2 is at position F and the foils are are connected to the circuit junctions indicated by j in Fig. 1. Scoring action begins when the closed circuit in the foil tip between tip and blade opens. Assume that *foil No.* 2 touches a foul, or invalid, area. A touch opens the tip contacts, applying a negative voltage to input transistor Q_{12} of the invalid-indicating bistable multivibrator. Integrating capacitor C_3 bypasses transients so the touch, to indicate, must be held until C_3 charges to the point of triggering the invalid multivibrator. The multivibrator flops over, lighting the white lamps, PL_5 and PL_6 and transistor Q_{15} sends an initiating signal to the timer and tone oscillator, as in epee. The timer, after a 2-sec discharge period, sends a disabling signal that prevents further scoring. This signal also goes to the tone oscillator to silence the audible signal.

The 2-μf value of C_3 requires a touch duration of about 0.004 sec. This requirement protects against a false invalid signal that could be caused by poor reel contacts and momentary openings of the foil tip.

If a touch is made in the valid area, opening of the tip contacts generates a signal to an invalid multivibrator and to a valid multivibrator. As integrating capacitor C_1 is smaller than C_3, the valid multivibrator flops over before the invalid multivibrator after *foil No.* 2 makes a fair touch. The valid multivibrator flops in about 0.002 sec. Actuation of valid multivibrator Q_1-Q_2 sends signals to the tone oscillator and timer as well as lighting PL_1 and PL_2.

Simultaneously a signal goes to transistor Q_{16}, which has the job of inhibiting (disabling) the invalid circuitry when a valid touch is scored. Conduction of inhibit transistor Q_{16} grounds the input of invalid multivibrator Q_{13}-Q_{14}, bleeding off the charge building up in C_3.

If a valid touch arrives and then glances to an invalid target the valid indication is the only one to register, since transistor Q_{16} has disabled the invalid multivibrator. However, if an invalid touch comes first and then glances to the valid area, both valid and invalid indications will show as long as the valid touch arrives before the timer disables all circuits. This action does not extinguish the previously illuminated invalid light; by the time a signal comes from transistor Q_{16}, the invalid multivibrator has flopped.

No touch registers from a touch made on the blade of either an epee or foil.

New Circuit Improves

Use of two discharge tubes that provide a shared cycle of operation makes possible design of a stroboscope with firing rate of 1,000 flashes per second. High-flash intensity and wide variety of triggering methods make instrument useful both in laboratory and industrial applications

By **L. H. BARRETT,** Electric and Musical Instruments, Ltd., England

FLASH RATE of a stroboscope is limited by the deionization time of gas in the discharge tube and by charging time of the discharge capacitor. The instrument to be described incorporates a circuit that overcomes these difficulties. The device meets a wide range of laboratory and industrial requirements. It increases the usual flash rate of 200 or 300 per second to a maximum of 1,000 per second. Other useful characteristics are an accurate indication of flash rate with several triggering methods as well as a high-intensity flash.

Improved Lamp Operation

The discharge circuit is shown in Fig. 1A.

Assuming no initial charge on C_1, the cathode of tube V_a is at ground potential, and application of a positive trigger pulse will initiate an arc discharge charging C_1 substantially to the voltage of the supply. Tube V_a now has no voltage across it, and the plate of V_a is at potential E. On the arrival of a trigger pulse to V_b, the capacitor discharges through the second tube, and the initial conditions are restored. Examination of the waveforms in Fig. 1B relating to this sequence of operations shows that the shared duty cycle provides an extended period for deionization.

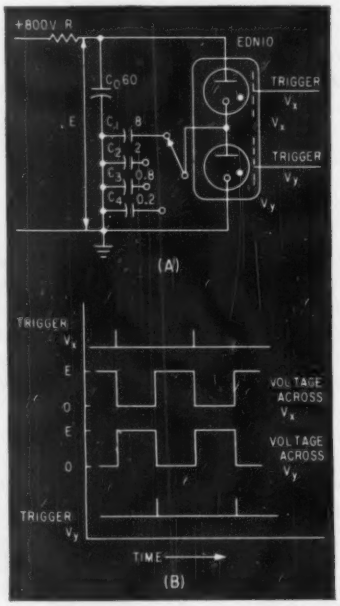
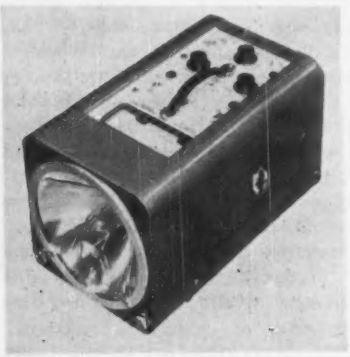


FIG. 1—Lamp circuit with range-switched discharge capacitors (A) is provided with an alternating trigger (B)



Stroboscope is a compact 18 × 10½ × 11 in. and weighs 36 lb

The method used to produce the two interlaced trains of pulses necessary for firing the lamp elements in alternating sequence is shown in Fig. 2.

The key unit is the oscillator/trigger circuit, which may be used as a pulse generator or a Schmitt trigger. The oscillator produces pulses of substantially square form and of short rise time. Their frequency is controllable over a range of 5 to 1, and four switched ranges yield a total frequency coverage ratio of 200 to 1. An internal synchronizing signal at power-line frequency may be switched to the oscillator when the stroboscope is used for viewing workpieces rotating at power-line frequency.

When the unit is used as a Schmitt trigger, there are several means by which the output pulse is obtained. The first of these is the application of a sine or square wave to the preamplifier. A photoelectric probe is provided, and this, coupled to the preamplifier input, projects a beam of light on to the surface of a rotating or vibrating object from which light of modulated intensity is reflected into the photocell producing signal pulses of a frequency related to that of the motion of the object under examination.

Stroboscope Versatility

Two-element flash tube gives a maximum of two million candles at five flashes per second and fourteen thousand at 1,000 fps

Built for complete portability, the 36-lb stroboscope can operate with the lamp three yards from the chassis. Design permits free air flow for cooling at the expense of operator access to certain components

To meet cases where it is convenient to operate a pair of contacts mechanically from the motion under observation, access to the trigger tube is provided such that each time the contacts are closed a pulse of 75-v amplitude is applied to the grid generating a pulse sequence at the trigger output.

The trigger may also be switched to an internal signal source at power line frequency for purposes of checking or resetting the calibration of the stroboscope ratemeter circuit.

The oscillator/trigger square wave is fed through differentiating networks to a triode version of the conventional Eccles-Jordan trigger circuit. Because of its bistable action in response to negative pulses applied to the grids, this tube pair generates two trains of square waves 180 degrees apart, each having half the frequency of the input wave. From these, narrow spike pulses are obtained by differentiation and applied to the inputs of two similar pulse generators from which the high voltage signals required for operation of the lamp are derived.

The output from one of the Eccles-Jordan circuits is also fed to a ratemeter circuit. This counts the half-frequency signal by integrating means, and the result is displayed on a 6-in. scale meter calibrated in terms of lamp flash rate. Another useful facility is the readout pulse fed from this circuit to an output terminal to which may be coupled auxiliary equipment for operation in synchronism with the flash or, where necessary, counting equipment of greater accuracy than the built-in ratemeter.

The frequency range switch on the control panel of the stroboscope operates ganged switch-banks in the circuits of the oscillator, the ratemeter, and the lamp unit.

Oscillator Trigger

Figure 3 shows details of the oscillator/trigger circuit, the mode of operation being controlled by a 3-gang switch. In oscillator connection, position 1, the circuit takes the form of a cathode-coupled multivibrator with the variable resistor controlling the turnover time. The steep-fronted output wave, as shown, has an amplitude of approximately 60v peak to peak. In the practical case, the value of C is switch-selected to provide four frequency ranges.

In positions 2 and 3 of the selector switches, the circuit is connected as a Schmitt trigger. An output wave similar to that of the oscillator is generated in response to any of the forms of input signal previously described.

The high voltage pulses necessary to fire the two flash tube elements

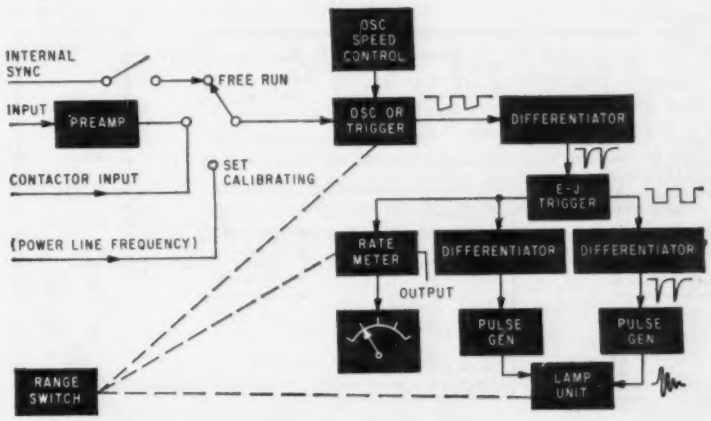


FIG 2—Block diagram of the complete stroboscope

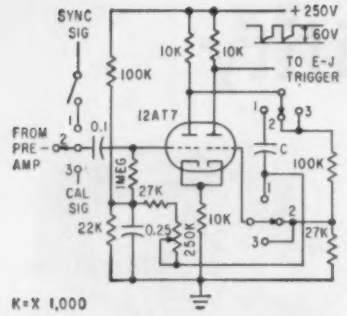


FIG. 3—Three ganged selector switches of the oscillator trigger give cathode coupled multivibrator or Schmitt trigger operation

of the lamp are generated by circuits shown in Fig. 4. One of these units is coupled to each plate of the Eccles-Jordan trigger, thus the outputs are accurately spaced to produce the required alternating trigger sequence.

In the quiescent state, V_2 is cut off because of the negative bias applied to its grid, while V_1 is drawing a small amount of plate current, thus holding both cathodes at a low positive potential. The incoming square wave is differentiated at the network C_1 R_1, and the negative voltage spike cuts off V_1. The resulting positive transient at V_2 grid switches V_2 to peak plate current. Since V_1 immediately regains a state of conduction, the grid potential of V_2 falls rapidly, returning the tube to cutoff.

Lamp Circuit

The arrangement of the lamp and its associated components is shown in Fig. 1A. The high voltage for the plates is obtained by full-wave rectification making it necessary to insert a series resistance, R, to protect the rectifiers from the very high peak currents drawn during lamp discharge. The effect of R is reduced, however, by the presence of C_s. During alternate lamp discharges, the selected capacitor, C_s, is charged from C_s to a voltage $V = E[C_s/C_s + C_s]$. If C_s is large compared to the highest value of C_s, the energy loss is small. The value of R is at the same time fixed at the lowest value affording adequate rectifier protection in order to minimize reduction of the voltage E as the mean charging current to C_s rises with increasing flash frequency. The switch, ganged with the range switch of the oscillator/trigger circuit, selects the discharge capacitor that gives maximum permissible lamp power at the highest flash frequency of the range.

The lamp consists of two U-shaped discharge tubes mounted on a common base and enclosed in a single toughened glass envelope. It is designed for maximum stability of the 300-amp peak arc discharge.

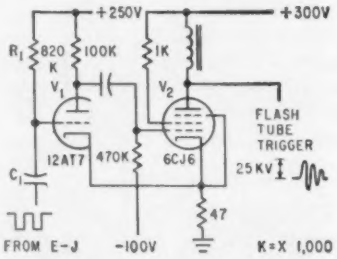


FIG. 4—Pulse generator's cathode-coupled resistor speeds the rate of change of current

The xenon filled tube produces a white daylight flash which, when mounted in a 9-in. diameter reflector, is magnified approximately 40 times.

Ratemeter

The flash rate is metered by measuring the mean charging current through a capacitor supplied from a pulse voltage of constant amplitude.

Referring to the circuit shown in Fig. 5, the square wave from the Eccles-Jordan trigger is applied to the grid of the pentode section. The plate load of this tube is of a value high enough to produce saturation on the positive-going grid excursion. The amplitude of the input signal is sufficient to produce cutoff on the negative swing. Since the positive supply line voltage is regulated, the output is a square wave of constant amplitude. This is then fed to the cathode follower stage, which supplies the metering circuit, in which a selected capacitor is charged to constant voltage at each signal pulse through the bridge rectifier unit and meter load. Capacitor C_1 provides sufficient damping to ensure an adequately steady reading down to the lowest frequencies.

The meter is calibrated by adjusting the charging voltage to give a correct reading on a known input frequency. Thus, on range 1, R_1 is first set to give the correct meter reading for an injected signal having a frequency near the center of the range after which R_2, R_3, and R_4 are set for signals of the corresponding range center frequencies. High stability capacitors minimize calibration drift of these ranges relative to range 1, and, under normal circumstances, it is necessary to adjust only R_1 to restore overall accuracy in the event of small changes in charging voltage. In the case of the triode section, the effect of slope variation is largely nullified by the high resistive loading presented to the cathode follower by the meter circuit.

The author wishes to thank F. R. Ellory, the directors of E. M. I. Electronics, Ltd., and Ferranti Ltd., for their cooperation and assistance in the design and development of this stroboscope.

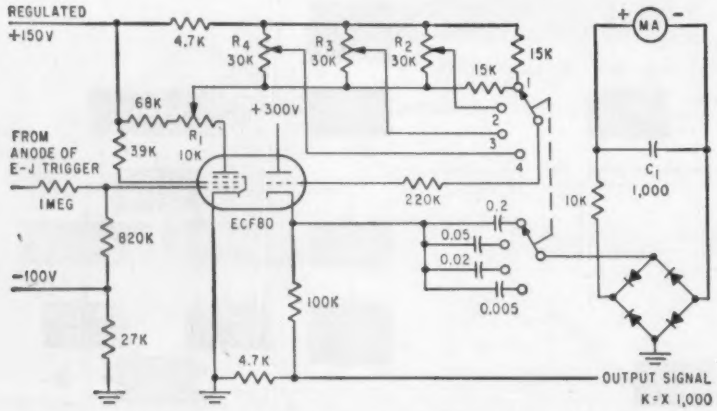


FIG. 5—Ratemeter circuit is provided with range switching and calibration facilities

Permanent Magnets at Extreme Temperatures

Alloy magnets can be used over a wide temperature range. Test data and equations are useful for design work

By **J. E. GOULD**, Permanent Magnet Association, Sheffield, England

AIRCRAFT, MISSILE and nuclear energy requirements are rapidly expanding the temperature range in which permanent magnets must operate. The changes temperature cycling can make are: (A) metallurgical changes which affect the hysteresis loop, (B) irreversible loss or decrease in magnetic strength (which can be recovered by remagnetization) and (C) reversible changes which can be substantial but disappear on return to normal temperature.

(A) Magnets are not normally used at temperatures where metallurgical changes occur and only rough estimates of such performance can be made. The widely used Alnico alloys, when correctly heat treated, are immune to such changes from −180 C to +550 C.

(B) Irreversible decrease in magnetic strength varies with the alloy and the dimension ratio or mean working point of the particular magnet. Alcomax III (US Alnico 5) operates with maximum energy when the working point is at a ratio, −B/H, of 18 to 20. If a magnet with a working point at these or higher ratios is cooled to −70 C, there will be no change in strength. In a shorter magnet with a lower working point, the flux loss will be 1 or 2 percent. The nondirectional Alnicos do not suffer from subzero temperatures but have higher losses from high temperatures. These effects are shown in Table I.

Table I—Temperature Characteristics of Some Alloys

British		Alcomax[a] III	Alcomax[a] IV	Alnico[b]	Alni[b]
USA (Alnico)		5	6	2	3
Properties at Room Temperature	B_r (gauss)	12,500	11,200	7,250	6,200
	H_c (oersted)	670	750	560	480
	$(BH)_{max}$	5.1×10^6	4.3×10^6	1.7×10^6	1.25×10^6
(A) Temperature for metallurgical change (deg C)		550	550	550	550
(B) Percent irreversible losses caused by:	−70 C	0 to 2	0 to 2	0	0
	300 C	1.0	1.1	5	11
	550 C	2.2	2.6	10	28
(C) Percent reversible losses after first thermal cycle at:	300 C	4	4	5	5
	550 C	9	9	13	13

(a) Directional or anisotropic grade (b) Non-directional or isotropic grade

The flux changes, both from high and low temperatures, are substantially completed on the first thermal cycle. Thus an Alnico permanent magnet can be stabilized against such changes by experiencing a thermal cycle greater than that which is effective in operation.

(C) Variation of magnetic strength in the usual temperature range is about −0.02 percent per deg C. For a wider temperature range, reversible changes up to 550 C can be expressed by a quadratic. For directional Alcomax the loss is given by: percent loss $= 0.01T + 0.13 \times 10^{-4}T^2$, where T is the temperature rise in deg. C. For nondirectional Alni and Alnico (US Alnico 3 and 2) the change is somewhat more: percent loss $= 0.01T + 0.27 \times 10^{-4}\ T^2$.

A summary of this data on the temperature behavior of typical directional and nondirectional alloys at temperature to 550 C is given in the table. The use of Alnicos, particularly the directional ones, at temperatures up to 700 C is not impossible but the changes are larger and less predictable. Periods of 20 hours upwards at 700 C are sufficient to reduce $(BH)_{max}$ of Alcomax III from over 5×10^6 to 2.0×10^6 and coercivity from 670 to 240. If a magnet is designed to suit such values (as by having excessive length), then a usable magnet up to 700 C may result, but only cut and try methods can be used to attain a specified performance.

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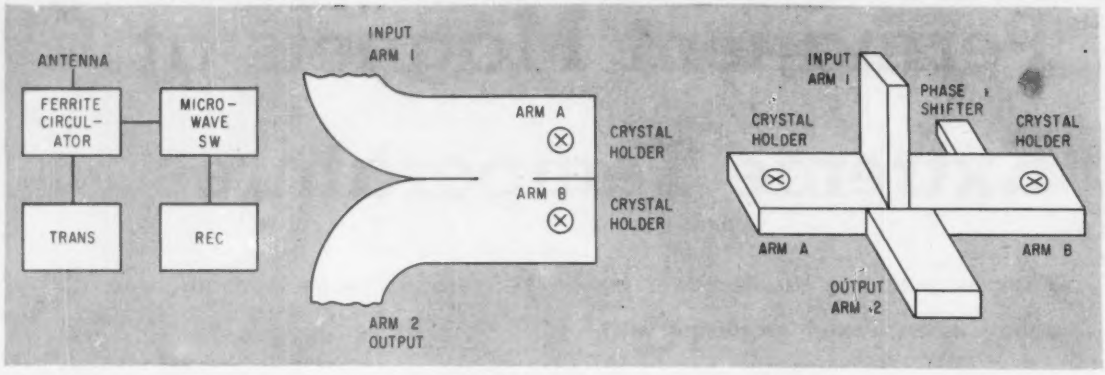


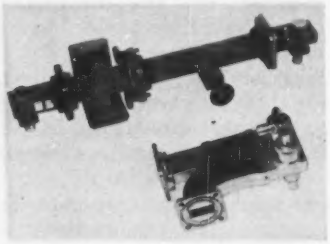
FIG. 1—Duplexing circuit has microwave switch for high isolation

FIG. 2—Short-slot hybrid absorption switch has wide bandwidth application

FIG. 3—Magic tee switch provides high isolation at the expense of bandwidth

Crystal Switches Bring

HIGHER REPETITION RATE duplexing systems provide an important key to more useful radar operation. Such fast switching operation may be obtained with a ferrite circulator, but its usefulness is limited by the amount of receiver isolation it provides. The circuit shown in Fig. 1 employs a microwave switch to absorb a large amount of the transmitter leakage signal that passes through the ferrite, without introducing excessive insertion losses.



Two types of absorption switches are the magic tee (top) and short-slot hybrid (bottom). Choice of switches is largely a matter of convenience

The switch, capable of absorbing 100 to 200 milliwatts, is an extension of the findings of earlier investigators.[1, 2, 3, 4] It gives an isolation of approximately 25 db with a minimum loss during the receiving period. It is operated by a 400 kc square wave having a 0.1 μs rise and fall time.

The frequency of operation is over a narrow region in X-band.

High isolation is obtained by using an absorption switch to dissipate incident transmitter leakage. Switching is accomplished by the use of a short-slot hybrid balanced mixer or a magic tee with crystal mounts in the coplanar arms. With proper biasing, the crystals are made to reflect or absorb the incident signal power.

An important advantage of the absorption switch is that at certain power levels its operation without external modulation is similar to that of a T-R tube. If no external bias is applied to the crystals, the switch has about 1 db insertion loss or less at incident powers less than 0.1 milliwatt. In tests using a 1N263 crystal, an increase in power resulted in a greater insertion loss. This loss reached a maximum of about 21 db at about 250 milliwatts. At powers above 250 milliwatts, the insertion loss drops to 10 db at 500 milliwatts. Since the switches are to be used at power levels of 100 to 200 milliwatts, they are self-operative. If switching operation were required at low or intermediate levels, modulation of crystal bias would be necessary.

A single switch can readily give an isolation of about 20 db, but isolation of nearly 40 db at power levels of 100 to 500 milliwatts is possible if cascaded switches are used. In such an operation the first switch is allowed to be self-operative, and the bias of the second switch is modulated.

Short-Slot Hybrid

A short-slot hybrid switch is shown in Fig. 2. If the crystals are removed from their holders and the sections are matched, half the signal power from the input arm will enter arm *A*, and half will enter arm *B*. The wave entering arm *B* from the input will differ in phase from the wave in arm *A* by 90 deg. The reflected waves from the short in arms *A* and *B* will again split at the interruption. The wave entering the output from *A* will be shifted in phase by 90 deg, and the wave entering arm 1 from *B* will be further shifted by 90 deg. The reflected waves at the input thus cancel while the sum of the wave amplitudes at the output is equal to the input amplitude. If perfect reflec-

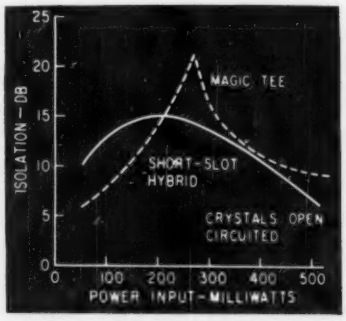


FIG. 4—At a given frequency of oscillation the magic tee provides greater isolation in the operating range

Receiver isolation in high-speed radar operation need not be limited by switching techniques. Absorption switches using semiconductor diodes greatly improve isolation making better operation possible

By **R. LUCY,** Applied Research Laboratory, Sylvania Electronic Systems, Waltham, Mass.

Greater Radar Utility

tion occurs in *A* and *B*, there is no loss, and the input power equals the output power.

The absorption crystal switch is designed about this structure. If isolation is desired between arm 1 and arm 2, the crystals are biased to match the characteristic impedance of the structure. Most of the power is then absorbed in the crystals and the output approaches zero. If the signal is to be transmitted, the crystals are biased to mismatch the structure, and the energy is reflected from the crystals and passed to the output. The insertion loss as well as the isolation is due primarily to absorption in the crystals.

Magic Tee

The magic tee operates on the same principle as the short-slot hybrid switch. Crystal holders are placed in the coplanar arms as shown in Fig. 3. A phase shifter adjusted to 90-deg phase shift per pass is inserted in one arm.

With the crystals removed, the signal enters arm 1 and splits into arms *A* and *B*. The signal passing down arm *B* will be reflected and arrive back at arm 2 in phase with the signal from arm *A*. The signals then add and pass to the output. With crystals inserted, a switching action can be obtained by biasing the crystals to match the line and absorb when isolation is required or by biasing them to a severe mismatch for maximum transmission. Isolations greater than 30 db with an insertion loss of less than 1 db have been measured. Slightly better high-power operation has been achieved with the magic-tee switch than with the hybrid.

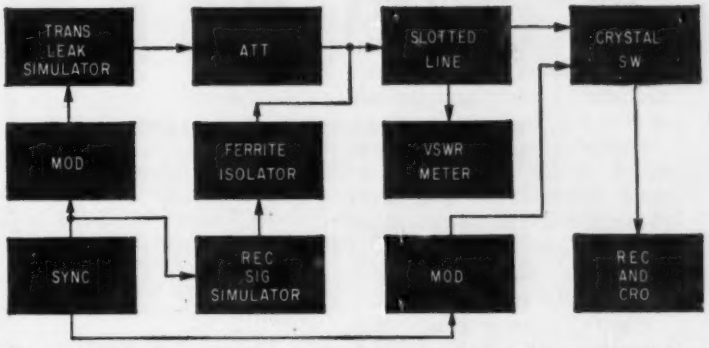


FIG. 5—A klystron is used as the transmitter leakage simulator, and a conventional signal generator simulates the received signal

The choice of a hybrid or magic tee absorption switch is largely a matter of convenience. Although Fig. 4 shows that higher isolation is possible with the magic tee, it is obtained at the expense of a narrowed bandwidth. This limitation is introduced by the phase shifter in the circuit; however, wide band phase delay circuits are available[5] which can make the magic tee as versatile as the hybrid.

Modulation Tests

At low leakage levels, crystal modulation is necessary. The experimental setup is shown in the block diagram of Fig. 5. A 500 milliwatt klystron gated at 400 kc simulates transmitter leakage. A simulated receiver signal of much lower level is fed in parallel with the klystron to the crystal switch. In actual practice the receiver signal will have approximately the same shape as the transmitter, but for the test it is sufficiently accurate to use a short pulse from a conventional signal generator timed to occur when the klystron is off.

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Graphical Analysis of Coupling Networks

Shows how to speed up design of resistor voltage dividers. Diagrams indicate relation of operating conditions to resistor and voltage-supply tolerances

By **JOHN G. KOCH**, Electrical Project Engineer, Motorola, Inc., Phoenix, Arizona

TIME AND EFFORT can be saved by using a graphical approach when designing resistive coupling networks. The graphical method to be discussed can be used for resistive-coupling problems when the load draws a negligible current and the network is not frequency dependent.

Referring to Fig. 1A, $E_o = E_i R_2/(R_1 + R_2)$. This voltage-divider relation is graphically shown in Fig. 1B. The graphical relation shows that $p/R_2 = 1/(R_1 + R_2)$. Consequently, $p = R_2/(R_1 + R_2)$ and $E_o = pE_i$.

Figure 2 is a nomograph which expresses the relationship between R_1, R_2 and p. The nomograph also shows R_1 and R_2 multiples of either the standard RETMA or MIL-R-10509 series and p with the equivalent voltage loss in db.

Several examples will be given to demonstrate the usefulness of the graphical approach.

Example 1

In the following example (No. 1), the problem is to directly

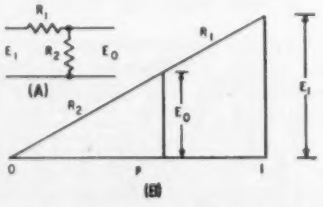

FIG. 1—Resistor voltage divider (A) and voltage-divider diagram (B)

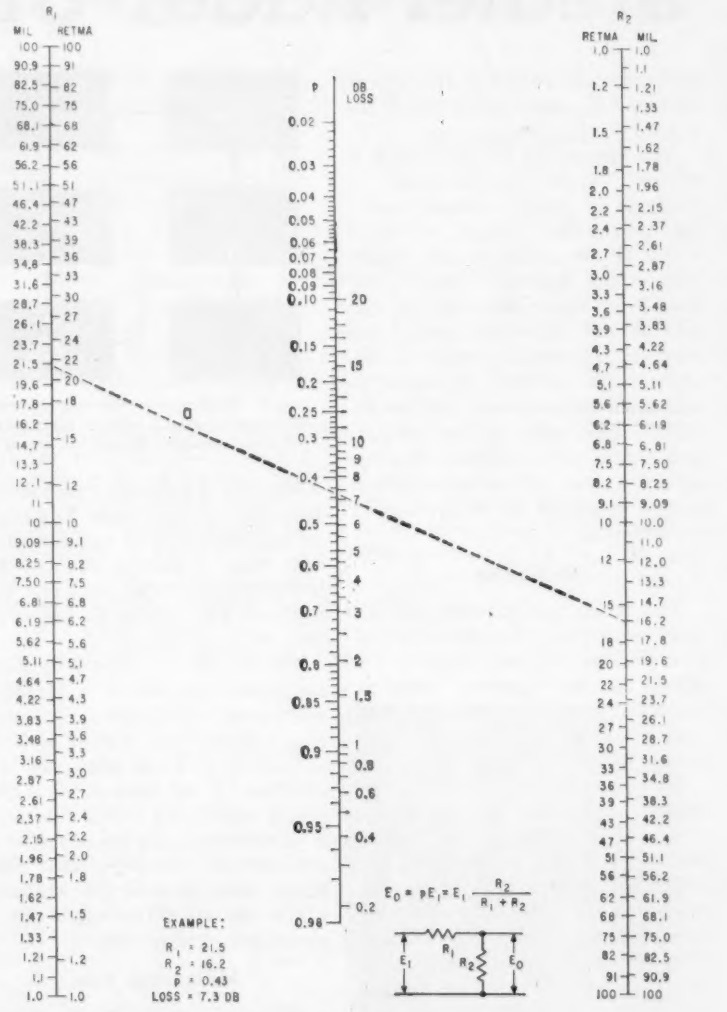

FIG. 2—Nomogram for designing resistor coupling networks

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***NOTE:** *Extended resistivity range.*

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couple the plate of a pentode video amplifier to the grid of the following stage with a network composed of two MIL resistors. Power supplies are +250 v and −150 v. Quiescent plate potential is 200 v and the desired grid potential is zero.

Sketch a voltage-divider diagram on graph paper (Fig. 3). Connect the $p = 0$, $y = -150$ v, point with the 200 v point on the

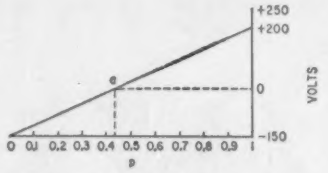

FIG. 3—Voltage-divider diagram for example 1

voltage axis. Find the intersection of this line with zero v (point *a*). Drop a line from point *a* to the *p* axis. This line gives the value 0.432 for *p*.

In Fig. 2, for $p = 0.432$, the attenuation is 7.3 db. Select a convenient value for R_1. Draw a line that joins this value of R_1 with the desired value of *p* and note the intersection of this line on the R_2 axis. Intersection may or may not fall on one of the standard values for R_2. Continue this until standard values for R_1 and R_2 are obtained, as indicated by line *a*.

To determine the value of resistors R_1 and R_2, assign an arbitrary value of 1 ma for the approximate current that will be drawn by the network. The sum of $R_1 + R_2$ is then (200 v + 150 v)/1 ma = 350,000 ohms. Multiply the R_1 and R_2 scales by 10^4 to fit this solution.

The values indicated by line *a* are $R_1 = 215{,}000$ ohms, $R_2 = 162{,}000$ ohms and loss = 7.3 db.

Example 2

The problem is to justify using 1-percent tolerance resistors in the network that has just been calculated and to justify using a 5-percent tolerance resistor in the plate circuit of the video amplifier rather than a ±20-percent composition resistor. Assume the quiescent plate current is 5 ma through a 10,000-ohm (±5 percent) plate-load resistor. The maximum deviation expected in the 1-percent-tolerance resistors is ±5 percent and the maximum deviation expected in the 5-percent tolerance resistor is ±20 percent.

Plate voltage can be anywhere between 250 v − (12,000 ohms) (5 ma) = 190 v and 250 v − (8,000 ohms) (5 ma) = 210 v. This excursion is due to expected plate-load resistor changes.

Construct a voltage-divider diagram. Mark the limits of the plate-voltage swing on the voltage axis and connect each point with point $p = 0$, as shown in Fig. 4.

Maximum deviation about the original *p* point will be ±5 percent due to changes in the precision resistors. Calculate the excursion of *p* and find these two points on the *p* axis. Draw a line vertically from each of these two points, thus intersecting the $R_1 + R_2$ lines. The area enclosed by these lines indicates the operating region of the grid under the assumed conditions. It may be necessary to explore the use of a precision resistor in the plate load to reduce the variation possible in grid potential. In this example the grid potential swings over a range of −12 to +13 v.

Example 3

A regulated power supply is to be designed to deliver 250 v. A reference of −87 v is to be used with this supply. A 10,000 ohm potentiometer (R_1, in Fig. 5) must adjust output voltage e_o over a swing of +5 v to −15 v.

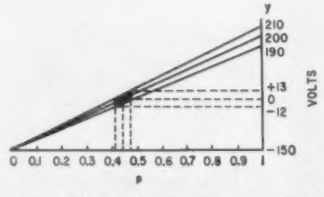

FIG. 4—Voltage diagram for example 2

Draw the basic voltage-divider diagram and extend the voltage axis from −100 v to + 250 v. Find the point $p = 0$ and −87 v. Connect this point with the +250 v point on the voltage axis with a straight line. Find p_2 by dropping a vertical line to the *p* axis from the point on the diagonal corresponding to +5 v. Similarly, find p_1 by dropping a vertical to the *p* axis from the −15 v point on the diagonal.

Current through this network is equal to [5v − (−15v)] divided by 10^4 ohms, or 2 ma. As this current is common to the network, $R_2 (p_2 - p_1) = R_2/(1 - p_2) = R_2/p_1$, and $R_3 = R_1 p_1/(p_2 - p_1)$, and $R_2 = R_1 [(1 - p_2)/(p_2 - p_1)]$.

In this problem, $p_1 = 0.215$ and $p_2 = 0.275$. Consequently, $R_2 = 121{,}000$ ohms and $R_3 = 35{,}800$ ohms. Use the nomograph to

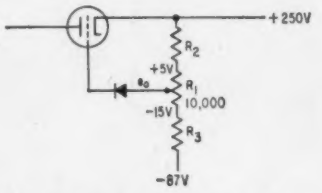

FIG. 5—Design of resistor voltage divider is discussed in example 3

select the nearest standard resistors.

Attenuation of the network is found by using p_1 and p_2. In this example the loss is between 13.3 db and 11.2 db.

Other Applications

Many other simple coupling problems can be solved graphically. An extension of the problem in EXAMPLE 3 might, for example, include the tolerances of the three resistors and the expected variation in the reference voltage. Another respresentative problem would be the design of a multivibrator to insure cutoff under all conditions of resistor and power-supply variation.

Wide Bandwidth with True Differential Input

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Multiple-Dish Radio Telescope

NEW-TYPE radio telescope at Stanford University is only half built but is already probing the sun's atmosphere with spectacular precision. When completed it will possess the highest resolution of any radio telescope in the U. S.

The project is being financed by grants from the Air Force Office of Scientific Research. At present it consists of 16 solid aluminum dish antennas interconnected mechanically and electronically, each 10 ft in diameter and mounted on a concrete pedestal. Ranged in a 375-ft row across a campus meadow, they are synchronized to move in unison, scanning the sun all day as it passes through the sky.

Later a matching row will bisect the first, making a cross of 32 dishes. The telescope's resolution will then be equal to that of a steerable dish antenna 375 ft in diameter. So far the largest is a 250-ft device in England.

A radio telescope's beam or resolving power varies inversely with its size. The beam of Stanford's radio telescope is now about 1/15 deg in one dimension and 2½ deg in the other. With its second row of dishes working, the beam will be only 1/15 deg in both dimensions.

THE FRONT COVER. Stanford University's as yet uncompleted radio telescope will have beam dimensions of 1/15 deg in both directions

Results may be recorded on paper tape, or a radio photograph of the entire solar orb can be completed in about 30 minutes. Clouds will not affect antenna efficiency.

At night, the telescope will be used to observe the stars, but it is designed primarily for studies of the solar chromosphere. A gooseneck waveguide in the center of each dish is tuned to 3 kmc, corresponding to microwaves from this region of the sun's atmosphere.

The telescope should help determine the height of the emitting regions above the solar chromosphere. It is thought that these fiery pillars are cylindrical. Theory has it that the different wavelengths received correspond to the depth of such pillars of flame.

Readout System Offers Very High Speed

DIGITAL readout can be done at rates up to 20,000 letters, numbers and symbols per second with a newly developed system. Called Videograph, the process can also greatly speed some types of communications and document reproduction.

The system by A. B. Dick Co. can translate binary pulses directly from a computer or from magnetic tape, paper tape or punched cards. It can either print results or display them on a tv screen.

The process can operate as a facsimile system for high-speed scanning and direct reproduction or transmission of graphic material, such as original documents or microfilm. Computer or facsimile information can be reproduced on cards, labels or sheets up to legal size for distribution or filing.

Another feature of the Videograph process is its ability to instantly print out pictures of moving objects which pass in front of a specially adapted tv camera.

Operation

For document reproduction, the master is read by a flying-spot scanner. The resulting video is applied to a special crt developed at Stanford Research Institute under the sponsorship of the A. B. Dick Co. A matrix of fine wires is imbedded in the face of the crt perpendicular to the face. Plastic-coated electro-

Remotely Controlled Bulldozer

Operation of bulldozers in hazardous areas is accomplished remotely with a standard Signal Corps radio. The system, performing 13 distinct functions to control the bulldozer, was developed at the U. S. Army Engineer Research & Development Laboratories, Fort Belvoir, Va.

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вычислительные машины
способствуют исследова-
нию языков

AUTOMATIC TRANSLATION

Computing machines aid language research at Ramo-Wooldridge

To formulate rules for automatic language translation is an enormously subtle and complex project. Yet significant progress is being made. During the past year of research at Ramo-Wooldridge over 60,000 words of Russian text have been translated and analyzed using an electronic computer. From the beginning several hundred syntactic and semantic rules have been used to remove ambiguities that are otherwise present in "word for word" translation. Our present computer program for automatic translation is a considerable improvement over earlier attempts.

Apart from the question of translation itself, electronic computers are invaluable for language research. The expansion of existing knowledge of the rules of language, through statistical analysis, is made practical by mechanized procedures. A clear symbiosis between linguistics and computer technology has emerged.

Automatic translation research is one of many R-W activities addressed to problems of communication of scientific information. These problems are increasing at an accelerating pace. In this area, as in others, scientists and engineers find at Ramo-Wooldridge challenging career opportunities in fields important to the advance of human knowledge. *The areas of activity listed below are those in which R-W is now engaged and in which openings also exist:*

Missile electronics systems
Advanced radio and wireline communications
Information processing systems
Anti-submarine warfare
Air navigation and traffic control
Analog and digital computers
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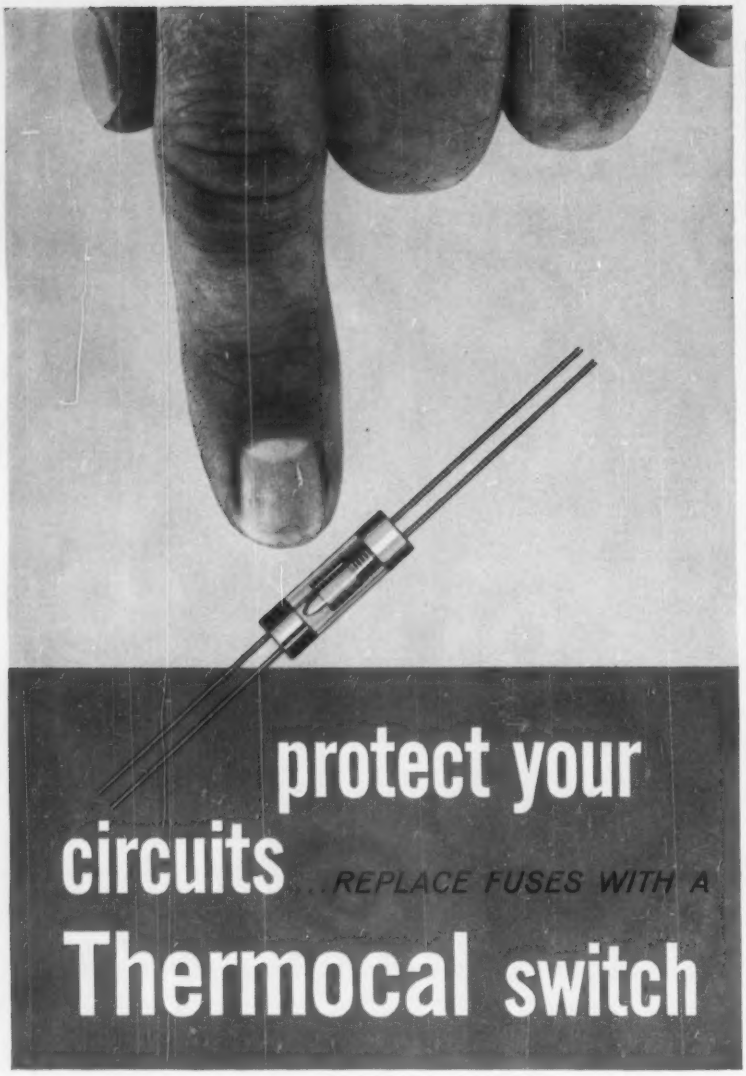

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statically charged paper is passed in front of the tube face so that it is also perpendicular to the wires.

Energy from the electron beam as it sweeps the crt face alters the charge on the paper directly with beam intensity. The latent image on the paper is thus a direct reproduction of the information contained in the video signal.

The unusually fast readout is attributed to the wire matrix. The wires are simply conductors and are not limited by response time.

If it is desired to transmit graphic material over great distances, the video signals may be transmitted over coaxial cables or via a microwave link. Synchronizing signals control timing of the equipment at the receiving site.

For use with digital computers, the digital data is converted to video signals. Buffer storage permits the Videograph system to edit the computer data for the particular application.

Applications

A wide variety of uses are foreseen for the equipment. For example, two systems will operate in conjunction with a new electronic computer being procured by a publishing firm in which about 10,000,000 subscriber records will be processed on magnetic tape.

The equipment will receive coded information from the computer tapes and edit it to reject unwanted information, such as expired subscriptions. Edited signals are sent to the printer, which will prepare rolls of magazine address labels at 36 labels per second. The machine has automatic paper splicing and roll changing mechanisms to permit completely uninterrupted operation.

The two printers will prepare over 10,000,000 address labels per week on a one-shift basis. This load is now being accomplished by eighteen machines working two shifts.

Radar Techniques Used to Study Ionosphere

APPLYING special radar techniques, the National Bureau of Standards has developed a promising technique for studying physics of the upper ionosphere.

Vhf waves are used, most of which pass through the ionosphere, including those layers that reflect lower frequencies. In passing, part of the vhf energy excites electrons in the upper atmosphere—above heights of 50 miles. This causes scatter, which returns low-power r-f to earth. A high-power vhf radar transmitter and special antenna are used to observe the vertically returned scattering.

This method of observing vertically returned scattering permits studies of ionization at all levels of the atmosphere, even above reflecting layers, well into outer space. Recent preliminary experiments detected results of scattering up to 400 miles. Refinements of the experimental setup are expected to extend range.

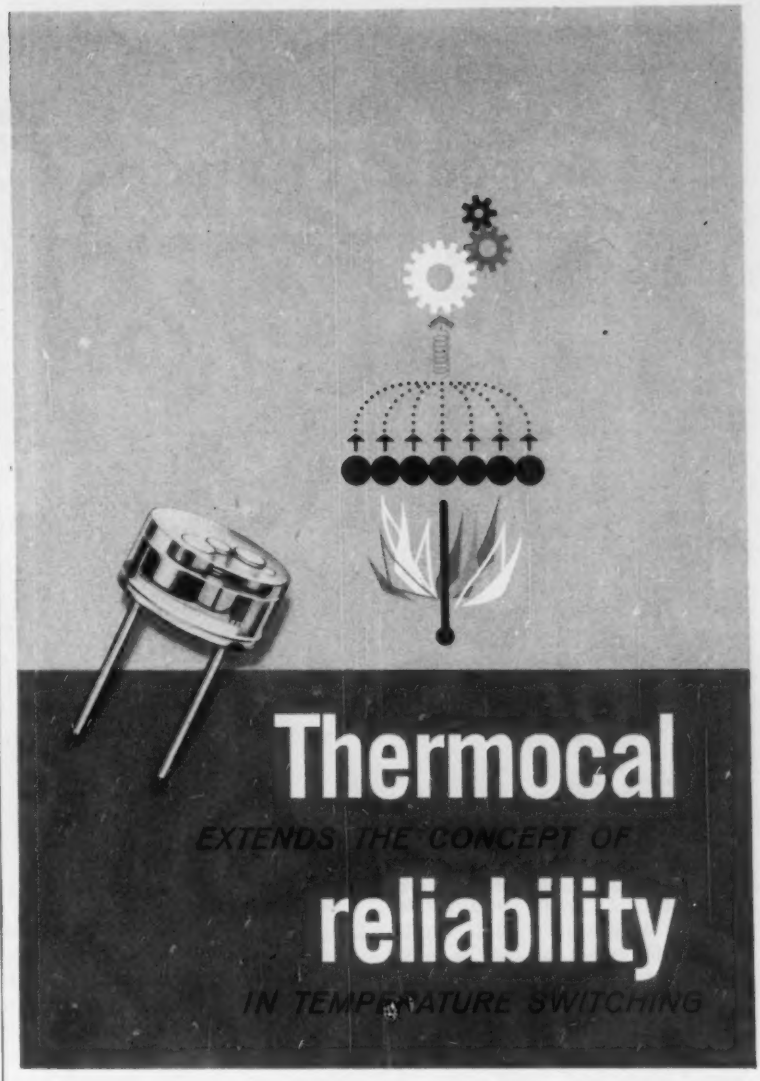
Until these experiments, radar-type ionospheric soundings depended on observation at high frequencies (3 to 30 mc) of intense reflections from ionospheric layers dense enough to reflect the wave completely. Thus, studies have largely been confined to determinations of heights and characteristics of maximum-density layers of the ionosphere.

Temperature Measurements

The technique should extend knowledge of the ionosphere by making possible temperature as well as electron-density measurements of the upper atmosphere. Such observations can confirm rocket-derived measurements but are more suitable for long-term studies of changes in the ionosphere due to diurnal, seasonal and solar activity variations.

Signals at 41 mc, generated by a transmitter capable of delivering 6 million watts peak power, are pulsed into the fixed antenna. Beam width of the antenna is about 4 deg. Pulses range from 50 to 150 μsec and are repeated at a rate sufficient to maintain an average power of 40,000 watts.

Four acres of land are covered by the antenna array, which is composed of 1,024 half-wave dipoles, 4½ ft above a ground-reflecting screen. Antenna operation was checked by total power recordings from the radio point source in the constellation Cygnus (Cygnus A), which happens to pass through the center of the beam.



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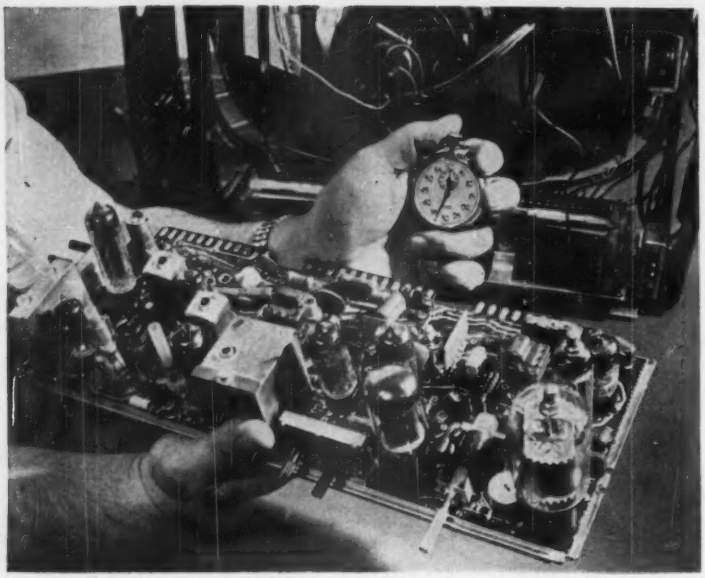
Circuit Board Printed in Full Color



A single color-coded printed circuit board contains the complete tv circuit. It takes only half a minute to remove the board from the chassis

A COMPLETELY COLOR-CODED printed circuit, developed by Motorola for a portable tv set, makes the job of tracing leads actually easier than working with handwiring.

Resembling a roadmap, the circuit board is printed in red, yellow, blue, green and black, plus the natural color of the copper leads. The circuit board provides a total of 14 individual color-code combinations of lead identifications following the well-known EIA standards.

Single Board

The 6 by 14.5-inch color-coded circuit board contains the tv schematic, on which every circuit can be traced from either side. Transfer of opposite-side color plating to observed side with black coding makes the plated circuit a single-sided board on each side. There is no need to turn the board over when tracing connections.

This innovation in printed circuitry will be used in one of Motorola's 17-inch portable tv models, designed, developed and built under the direction of Chief Engineer Karl Horn of Motorola.

All connectors between the plated circuit board and its power supply and associated receiver parts with the exception of four simple clip connectors are made by inserting the board into three special female connectors with 12 contacts each. Thus the board can be removed from the set by loosening three screws, disconnecting four clip leads, and activating a spring loaded lever device which ejects the board. Complete removal of the board, or loosening it for trouble shooting takes in either case about half a minute.

All components are easily reached and all parts in the circuit can be tested by simply removing the back cover of the tv set.

The entire bottom of the set is completely clean, with no obstruction to hinder the service man in his trouble shooting.

The board is reinforced with fiberglass for improved strength against impact and flexing.

More than 20 sets were tested through 20 cycles each. Each cycle consisted of immersion of the set in a cold chamber at −40 C for four hours and then immediate immersion in a humidity chamber at 85 C and 95 percent relative humidity for 16 hours and then an operational test of four hours at room temperature.

In addition, 45 more sets were run for 4,000 hours under special cycling conditions at a line voltage of 135 v which is equivalent to a normal usage by the average customer of 10.8 years.

Also, a battery of the usual tests such as flexing, peel strength, corrosion, salt spray, insertion and removal tests and contact pressure tests were applied to the board. Results showed a high degree of reliability and ruggedness.

Improving Performance Of Power Transistors

A NEW TRANSISTOR structure, described by Herbert Nelson in RCA Review, June, 1959, p. 224, has a geometry that augers well for the improvement of silicon power transistor performance. The new geometry should benefit transistors made of gallium arsenide and other materials where surface recombina-

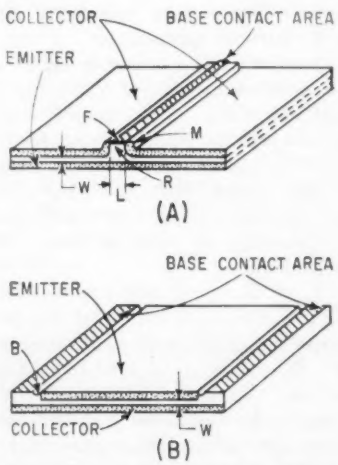


FIG. 1—New transistor structure, A, compared to conventional transistor structure, B

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Type TR 1/10 watt—actual size

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You can drastically reduce size—while establishing new and higher levels of reliability—with Allen-Bradley Type TR resistors. Although incredibly tiny, these time tested miniature resistors are made by Allen-Bradley's exclusive hot molding process that *assures complete freedom from catastrophic failures!* The Type TR resistors are conservatively rated 1/10 watt at 70° C.

Remember that all the benefits of designing smaller and smaller circuit modules are lost if reliability must be sacrificed. You obtain *all* the advantages of size reduction—without resorting to experimental wafer-type configurations—by using standard A-B miniature components that have been proven over the years.

For detailed specifications on the complete line of A-B quality electronic components, send for Publication 6024

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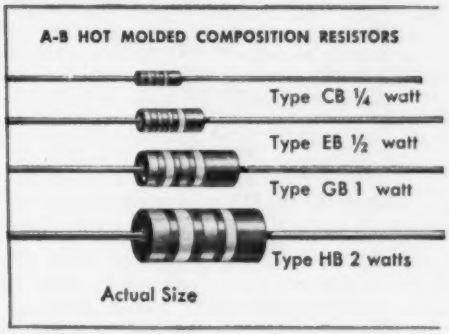

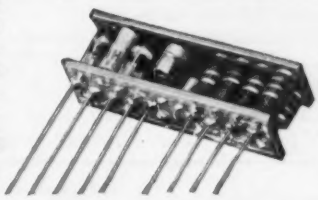

This shows still another type module packaging which uses A-B Type CB ¼ watt composition resistors.

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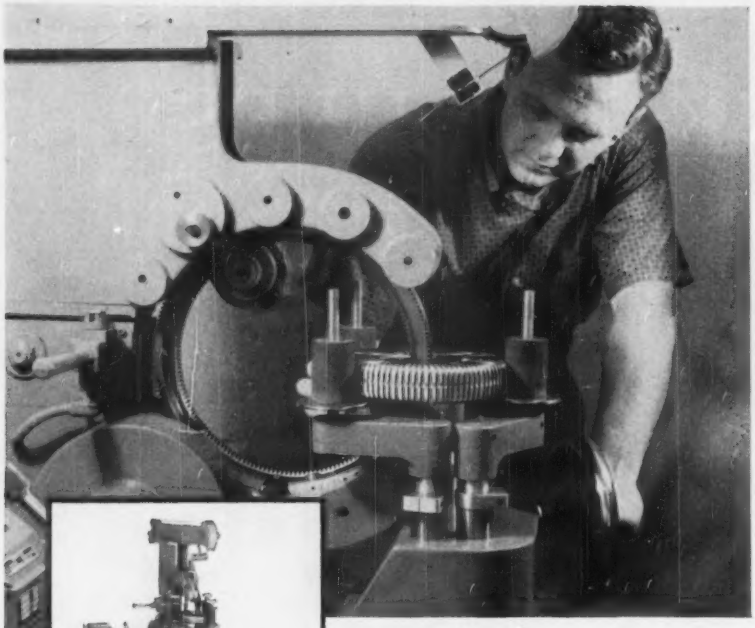

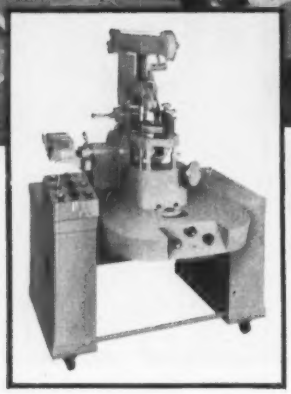

NEW BOESCH MAXITOR

winds toroids from #40 to #7 wire . . . using 3 interchangeable heads

Boesch's new MAXITOR Toroidal Coil Winding Machine covers a wide range of applications, including exceptionally large diameter, heavy wire gauge winding jobs. The coil shown above is typical. It is being wound with #10 wire on a MAXITOR machine using Boesch's HW-200 winding head and continuous-winding core holder. Segmental-winding holder is also available.

Two other interchangeable heads are available which make MAXITOR a really versatile machine. The HW-300 head winds wire gauges as large as #7 to finished O.D. as much as 14". HW-100 handles gauges from #40 to #22 to maximum O.D.'s of 10".

And MAXITOR is packed with "dream" features. Pushbutton drive ring and magazine positioning saves set up time. A dial control on the operator's panel provides micrometer brake settings for easiest variable speed tension control. Turn spacing is infinitely variable at the turn of a knob. And the range of winding applications for MAXITOR is apparent in the table below.

Head Type	Min. Final I.D.	Max. Final O.D.	Max. Final Height	Wire Range AWG #
HW-100	½"	10"	6"	40 to 22
HW-200	1"	10"	6"	24 to 10
HW-300	2"	14"	10"	20 to 7

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BOESCH MANUFACTURING COMPANY, INCORPORATED
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tion tends to be extremely high.

The base region, Fig. 1A, is brought to an external surface through the central region of the collector. This configuration is characterized by a high degree of minority-carrier conservation and surface immunity.

Called a surface-immune transistor, the device effectively eliminates the recombination of injected carriers on the surface between the emitter and the base-lead region. Such recombination is particularly troublesome in conventional silicon transistors.

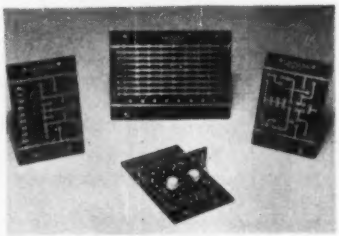
In the new structure, the flow of base current is inward from the emitter and collector perimeters to the base lead. A forward-biasing effect crowds injection towards the central area of the emitter where no opportunity for surface recombination exists.

Several lots of experimental silicon transistors of the new geometry have been prepared and tested. Results also show that the base and saturation resistances are considerably lower than those of comparable conventional units.

The current transfer ratio of the conventional units vary greatly with surface changes, while that of the new geometry remain substantially unchanged. The current transfer ratio decreases with an increase in the width, L, of the internal base-lead channel. When the normal and inverted operation of two surface-immune transistors are compared, results show a high degree of symmetry.

Results also show that values

Prototype Circuitry



Basic circuit boards which cover all circuit functions for analog and digital circuitry, greatly simplify circuit testing and design problems. The breadboards have been introduced by Dynex Inc., of Los Altos, California

for an inverse current transfer ratio are not greatly lower than of the normal current transfer ratio. An inverse current transfer is more affected by surface treatment than is the normal current transfer. This is probably caused by surface region *M* (see Fig. 1A) which should have greater effect upon minority carrier loss in inverted than in normal operation.

The low saturation resistance of the surface-immune transistor is strikingly evidenced by the early sharp rise of collector current with voltage. Saturation resistances of the surface-immune and the conventional units are 0.4 and 2.5 ohms respectively.

Importance of the structure is less for transistors made of germanium where surface recombination can be low.

Radomes for Supersonic Craft

A SILANE modified phenol-formaldehyde resin, which retains its strength after exposure to temperatures of 600 F for hundreds of hours, is available in commercial quantities from Monsanto Chemical Company's Plastic Division, Springfield, Mass.

The new material, tradenamed Resinox SC-1013, was developed especially for use with fibrous glass and asbestos reinforcements to make radomes for supersonic aircraft. Because of its excellent performance in the 500 to 600 F range, it is expected to be used in other applications where temperatures have prohibited the use of plastics. Resinox SC-1013 has high-frequency electrical properties and high-temperature performance characteristics several times better than conventional phenol - formaldehyde resins.

Late last year, the company announced the development of a special phenol-formaldehyde resin, Resinox SC-1008, to protect missile nose cone against the 10,000 F and up heat generated during the space-to-earth reentry.

Both products are the result of a special research program to develop materials for space.

NEW BOESCH MINITOR

. . . machine - winds 1/32" toroids

The coil shown above is a 1/32" residual I.D. toroid being wound *by machine* on Boesch's new Model MW400 MINITOR. It's the smallest machine-wound coil ever made (only half as large as the smallest previously available), and it can only be wound on MINITOR!

This achievement reflects a completely new, unique method of coil winding perfected by Boesch. The wire is loaded *inside* a hollow, round cross-section shuttle, and the winding is spun out. A single loading of this unique shuttle is usually enough to wind several coils.

MINITOR handles wire sizes from #36 to #50 AWG, and winds up to 500 turns per minute. Maximum finished coil size is ¾".

Shuttles for MINITOR are loaded by a Boesch PW-100 Loader. This machine can service as many as 20 winding machines, and it can load needles for hand winding as well.

If you now own a Boesch SM series machine, you can convert it to MINITOR operation economically by buying a 400-200 Head, a 400-300 Core Rotating Assembly, and the PW-100 Loader.

WRITE TO US TODAY for complete specifications, delivery schedules and prices on MINITOR.

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CIRCLE NO. 133 READER SERVICE CARD 133

Punched Cards Sort Transistors

By E. G. MILLIS, GeoSciences and Instrumentation Div., Texas Instruments, Inc., Houston 6, Texas

TRANSISTORS may be sorted at rates up to 2,100 an hour in the automatic production testers described here. Normal speed, for the version which uses punched cards to control sorting and rejection, is 1,200 an hour with a crew of 4 loaders and 1 technician.

Transistors are hand-loaded into test blocks. Cards are inserted in clips on the blocks and act as a 20-bit memory. The cards permit up to 20 go-no-go tests. The blocks are driven along the track by a pneumatic ram.

Four pretest stations prevent loading errors. One stops the line if a card is mislocated. The second removes improperly-loaded transistors. Another checks for correct type, *npn* or *pnp*. The last removes shorted or punched-through units.

Remaining test stations are identical except for plug-in cans containing test circuits. The console (Fig. 1) contains the master cam timer and the following regulated power supplies: relay, photocell amplifier, +250 v test circuit and −250 v test circuit. Shutoff circuit feeds back to the cam timer.

A typical test station is diagrammed in Fig. 2. Resistive networks set up each test specification with an accuracy of 0.5 percent. Transistor output is compared with standard voltage or current generated with mercury cells. A punch is actuated if the transistor exceeds the standard. Placement of the hole in the card identifies the test failed. As the test blocks transfer to the next station, the stations are calibrated with precision resistors.

Sorting stations are identical to each other except for masks which may be changed as required. Light source, card, mask and photocell are lined up in that order. The photocell feeds into the amplifier of Fig. 3.

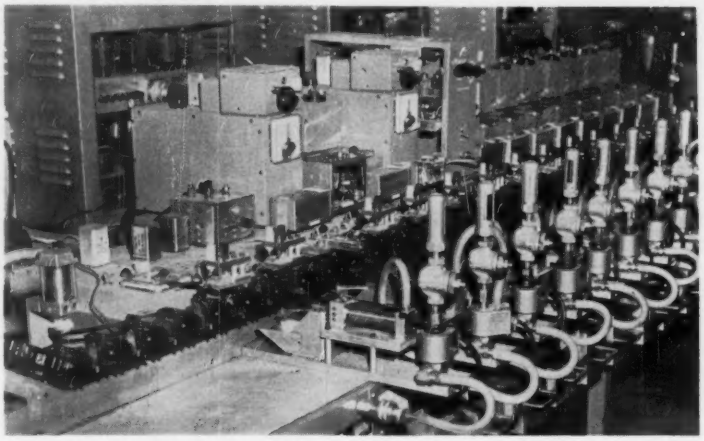
If there are no coincident holes in the card and mask, it indicates the transistor has passed all relevant tests. The transistor is pulled from the block (via the pull selector switch S_1 and the pull relay) by a hook and drops into a bin.

Coincident holes permit the transistor to pass with its block to the next sorting station. If no station pulls the transistor, it is a reject.

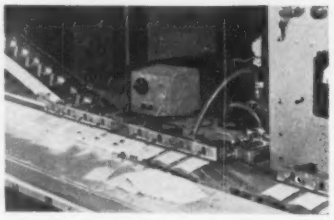
While transistors are being transferred, the photocell assembly is checked by the light shining in the gap between one card and the following card. If there is no response, alarm and shutoff relay is actuated.

All d-c power and timing signals are supplied by the control console. The master cam timer has 8 cams driven by a variable speed d-c motor. A-c test boxes are placed directly over the track contacts.

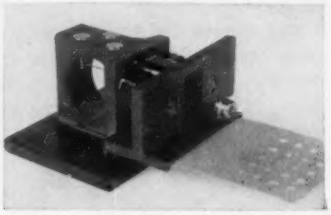
If only 1 type of transistor is to be tested, the cards and sorting stations are not required. In place of a punch, the test stations each have a grasping mechanism which removes transistors and places them in bins. Either good units or rejects may be selected. Punching and



Simplified version of automatic tester. Transistor in blocks travel through test stations until it meets requirements. Graspers at each station select satisfactory units. Rejects drop in a bin at end of line



Loading station. Blocks are supplied on ramp at left



Transistor test block with card in position. Card acts as 20-bit memory

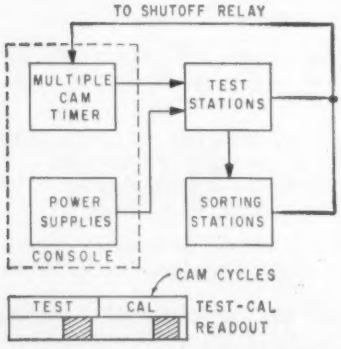
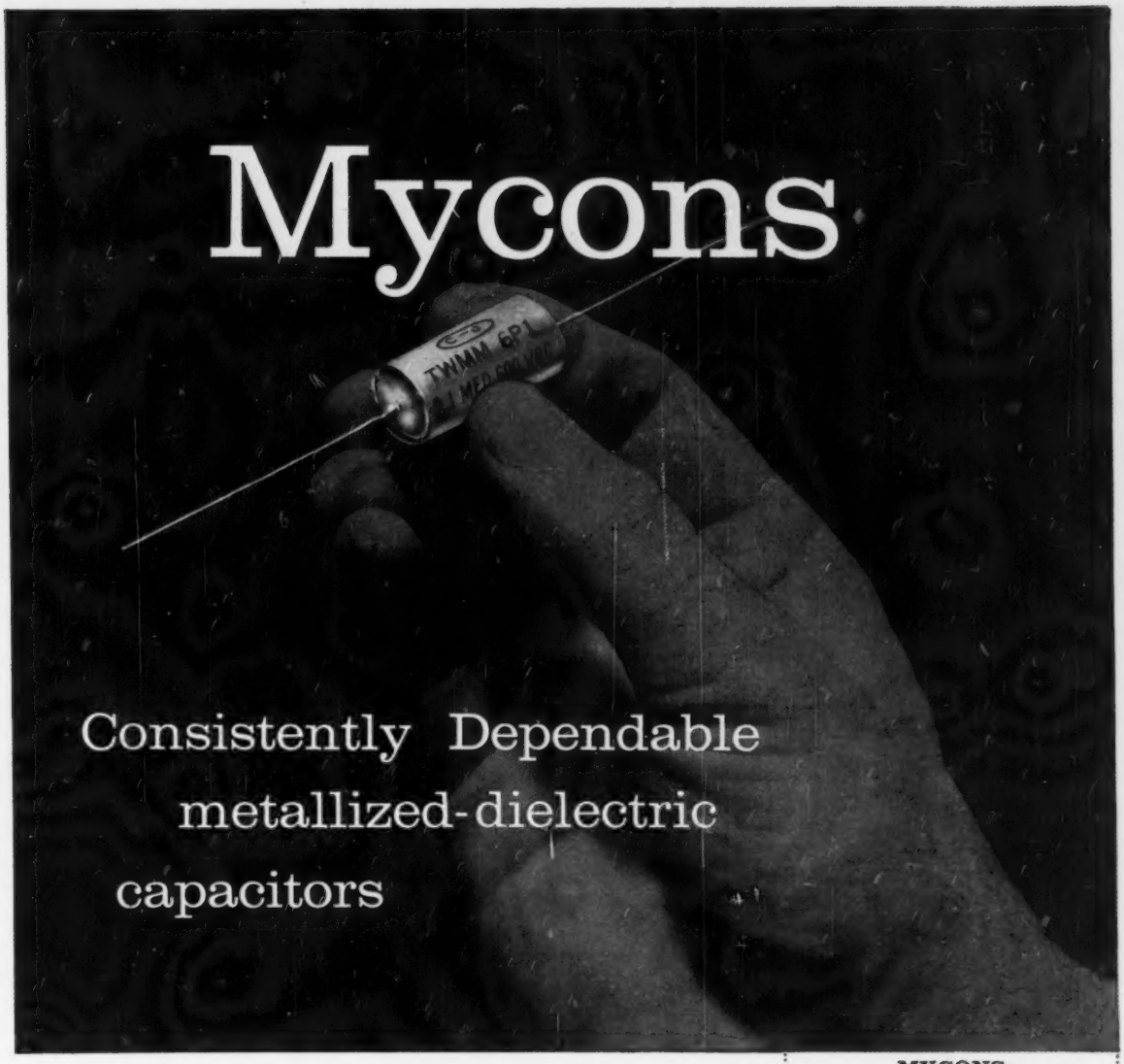


FIG. 1—System block diagram and cam timing cycle chart



New Metallized Mylar* (Type TWMM) and Mylar-Paper (Type MTWK) Capacitors by Cornell-Dubilier.

Whether you specify miniature metallized capacitors for military or industrial electronic equipment—for critical power-supply filter circuits or bypass applications—Cornell-Dubilier's new MYCON metallized capacitors assure top performance and dependability. Backed by over 47 years of capacitor engineering and manufacturing leadership, MYCONs combine better high-temperature operation and better insulation resistance with low dissipation factor and fault count. Available in a wide choice of mounting styles, MYCONs meet the requirements of applicable military specifications. For complete specifications, write for Engineering Bulletins 190 and 185 to Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.

*Du Pont Reg. T.M.

MYCONS

TYPE TWMM—
Metallized Mylar*

TYPE MTWK—
Metallized Mylar and Paper Film

Specifications and Features

- Ratings from .01 mfd. to 12.0 mfd. Voltages of 200, 400, or 600 volts DC Working.
- Wide useful temperature characteristics within range of −55°C to +125°C.
- Hermetically sealed in miniature tubular metal cases with metal-to-metal end-seals.
- Wire lead or solder lug terminals.
- Various bracket-mounting or threaded-neck mounting styles.

Consistently **CORNELL-DUBILIER** *Dependable*

CAPACITORS

CIRCLE NO. 135 READER SERVICE CARD 135

See the new Bradley REDTOP® at WESCON Booth #3715

STUD MOUNTED INSULATED BASE

a new solution to an old rectifier problem

The first engineer who "integrated" an eraser with a pencil inspired Bradley's latest accomplishment. Our boys took a hard look at the mess of washers, grease, and sundry hardware required in a conventional rectifier heat sink assembly, and decided to make engineering history again. Between coffee breaks, they tested 163 varieties of alumina-loaded ceramic wafers, found the right combination of electrical insulation + heat transfer characteristics, and brazed together a one-piece, insulated base rectifier that cuts assembling labor, shrinks bridge size, and out-performs other heat sink methods. *If you'd like to unfold the sheet that bares the facts about our new 6 and 12-amp REDTOP® rectifiers, drop us a card.*

BRADLEY SEMICONDUCTOR CORPORATION
Formerly Bradley Laboratories Inc.

Bradley®

275 WELTON STREET, NEW HAVEN 11, CONNECTICUT

grabbing stations may also be used on the same line.

Testing and sorting stations are built in modular units complete with track and can be arranged or replaced to suit the test and sorting system desired. Reject level

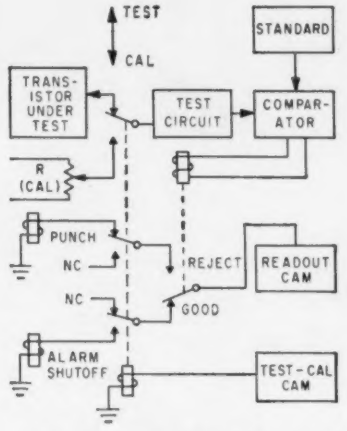


FIG. 2—Test station. A reject is indicated by punching the card. All switches are in test position "good"

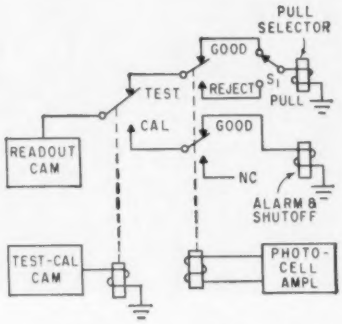


FIG. 3—Sorting station. Pull switch and relay remove the transistor from the block

specifications are changed by varying standard current or voltage level and calibration resistor. Changes in test conditions require a new test box. Other major assemblies are plug-in units.

Insulating Tape Makes Electroplating Mask

PRESSURE-SENSITIVE insulating tape is an effective electroplating mask, according to John Gombos Co., Inc., Clifton, N. J. The photos demonstrate its use in selective copper flash and gold plating of gyro frame

Taping gyro frames before plating

Clean edge of plating is seen as tape is stripped after plating

areas to be soldered. The firm also uses the technique in other types of plating.

Metal will not be plated on the tape. It conforms to irregular surfaces. Masking errors can be readily corrected by stripping and retaping. Taping avoids any preliminary masking which paint-on masks might require. Baking and chemical stripping, which might affect the plating, are not needed.

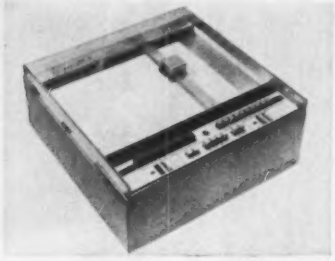
After plating, the tape is stripped off. The edge of the plated area will not peel if the parts were clean and the copper flash is sound. The plated metals will not adhere to the tape.

One-inch tape (Minnesota Mining and Manufacturing Co. 470, or equivalent) is used. A nonconducting tape is required to avoid plating through the tape. The tape is applied in parallel strips ending a fraction of an inch away from the edges of the area to be plated. The edges are trimmed with tape placed along the edges. Sufficient overlap is allowed to prevent any gaps or paths through wrinkles in the tape. Rubber plugs can be used to individually mask holes.

Linde RARE GASES
MAKE THEM EQUAL
One tiny glow lamp made by Signalite Incorporated now replaces a standard electron tube. The secret: a fill gas LINDE technicians created from rare gases—neon, argon, krypton, and radioactive krypton 85—allowing Signalite's new manufacturing techniques to be put on a production line basis. LINDE gases aided in increasing current from 0.3 to 20 milliamperes—in light or total darkness—a change that would otherwise require a 40-fold increase in size. Best of all, the cost went from $3.00 to $.17 per lamp.
Uses for these lamps include subminiature voltage regulating tubes, switching devices, lightning arrestors, electronic power supplies, protective devices on explosive equipment, and bright pilot lights. Your own products might similarly benefit from LINDE's technical service and experience in rare gases. For data on the physical and electrical properties of these materials, write Dept. BD, Linde Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. In Canada: Linde Company, Division of Union Carbide Canada Limited.
Linde
RARE GASES
Symbol of Highest Purity
UNION CARBIDE
LINDE and UNION CARBIDE are registered trade marks of Union Carbide Corporation.

CIRCLE NO. 137 READER SERVICE CARD

On The Market
at the WESCON Show



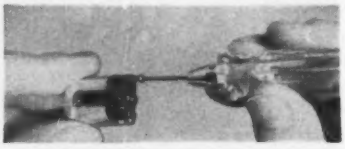
X-Y Plotter
pushbutton-operated

LIBRASCOPE, INC., 808 Western Ave., Glendale, Calif. Model 210 X-Y plotter offers immediate scale switching by pushbutton methods with vernier control permitting scale expansion to the next setting. This permits the operator to expand between scale voltages to fill the entire plot area. A flat vacuum platen and provision for precision positioning facilitates paper alignment and loading. Unit features a static accuracy of ±0.1 percent of full scale and a dynamic accuracy of ±0.2 percent of full scale at 10 ips tracing speed.

CIRCLE NO. 240 READER SERVICE CARD

Socket Screws
miniature

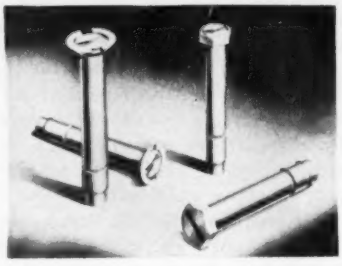
THE BRISTOL CO., Waterbury 20, Conn. Precision screws in sizes No. 0, 1, 2 and 3 are available in button-head, flat-head, cap and set screw styles, with either spline or hex sockets. Heat-treated alloy or stainless steel is standard, other metals are available.



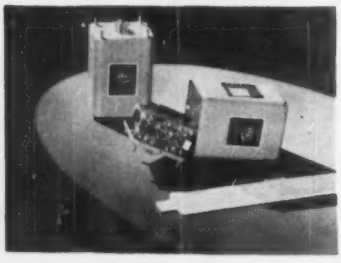
CIRCLE NO. 241 READER SERVICE CARD

Fasteners
blind-type

STANDARD PRESSED STEEL CO., Jenkintown, Pa. Sleev-Lock, a removable and reuseable blind-type fastener, can be inserted, tightened and later removed from the one side of a panel with an inexpensive attachment to a power tool. Two available configurations—the 100-deg flush head type and the hex head protruding type—each consist of an outer sleeve, nut and inner core bolt, all preassembled in a single unit. Driving attachment holds outer sleeve stationary in hole, while driving core bolt to pull nut up over knurled end of sleeve.



CIRCLE NO. 242 READER SERVICE CARD



Power Packs
miniaturized

ELECTRONIC RESEARCH ASSOCIATES, INC., 67 Factory Place, Cedar Grove, N. J. TR6R-TR32R series Transpacs are solid state high-current short-circuit and transient-proof designs. They are highly regulated self-contained a-c operated units which provide adjustable d-c outputs at all standard battery voltages. Models are available for output voltages of 6, 12, 18, 24 and 32 v at 0-2 amperes load current. Also available is a multi-output design which permits selection of any of those listed voltages within a single package.

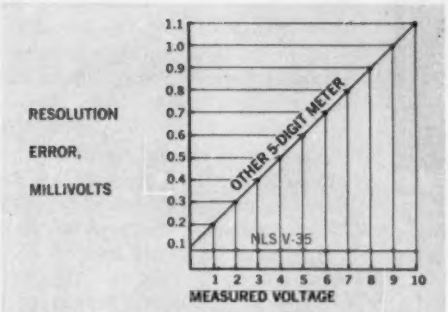
CIRCLE NO. 243 READER SERVICE CARD

Resolvers
feedback winding

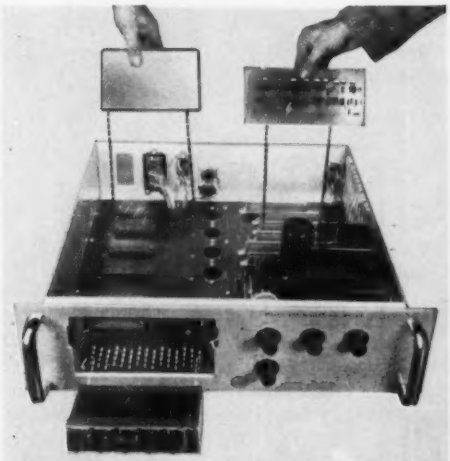
CLIFTON PRECISION PRODUCTS CO., INC., 9014 West Chester Pike, Upper Darby, Pa. Size 8 feedback winding resolvers designed for use with transistorized amplifiers permit the solution of spherical triangles in a cascaded resolver chain. Functional error is 0.1 percent or less; winding perpendicularity ±5 minutes. Elec-

FIRST DIGITAL VOLTMETER WITH THE FACTUAL FIFTH FIGURE

+96.438



This chart shows the significant resolution error that results in other five-digit meters as compared to the NLS V-35 with the *factual fifth figure.*



Compact, plug-in design of the NLS V-35

The All-Transistorized NLS V-35

Here for the first time is a *true* five-digit voltmeter with a factual fifth figure. Increased accuracy of *full* five-digit resolution — 0.001% — results from the new mathematically perfect logic of the NLS V-35.

Other five-digit digital voltmeters require "desensitizing" to prevent oscillation of the least significant digit. This results in a resolution error of three to nine digits in the upper portions of each range as graphically displayed in the chart to the left. This comparison clearly shows the increased accuracy of the NLS V-35, made possible by full five-digit resolution.

In new logic . . . in all-transistorized circuitry, including logic . . . in new simplified design with *plug-in* circuit boards, *plug-in* oil-bathed stepping switches, and *snap-in* readout . . . the NLS V-35 leads its field. Write today for complete information.

NLS V-35 Specifications

Measures Voltage from ±0.0001 to ±999.99, Ratio from ±.00001 to ±.99999 . . . 10 Megohm Input Impedance . . . 0.01% Accuracy . . . Automatic Selection of Range and Polarity . . . And Measures Three Times Faster Than Any Other Stepping Switch Instrument.

Originators of the Digital Voltmeter

non-linear systems, inc.

DEL MAR (San Diego), California

NLS — The Digital Voltmeter That Works . . . And Works . . . And Works!

WESCON Booth No. 1416

CIRCLE NO. 139 READER SERVICE CARD 139

When Top Quality Capacitors Are Required Specify Pyramid Mylar® or Tantalum

Miniaturized to provide maximum space economy.

New Pyramid Tantalum slug capacitors have cylindrical cases and contain a non-corrosive electrolyte. Due to the special construction of materials used in the manufacture of Pyramid Tantalum slug capacitors, these units are both seep and vibration proof. In addition, this type of capacitor assures long service life and corrosion resistance—made to meet MIL-C-3965 Specifications.

Commercially available immediately, these new Pyramid Tantalum capacitor units have an operating range between —55° C to 100° C for most units without any de-rating at the higher temperature.

Pyramid new Mylar capacitors have extremely high insulation resistance, high dielectric strength and resistance to moisture penetration.

Commercially available immediately, Pyramid Mylar capacitors have an operating range between —30° C to + 125° C with voltage de-ratings above +85° C. Pyramid wrapped Mylar capacitors—Series Nos.: 101, 103, 106 and 107 have the following characteristics:

Construction Styles:	Basic No.	Type Winding	Shape
	101	Inserted Tabs	Flat
	103	Extended Foil	Flat
	106	Inserted Tabs	Round
	107	Extended Foil	Round

Tolerance: The standard capacitance tolerance is ± 20%. Closer tolerances can be specified.

Electrical Characteristics: Operating range for Mylar capacitors—from —55° C to +85° C and to +125° C with voltage de-rating.

Dissipation Factor: The dissipation factor is less than 1% when measured at 25° C and 1000 CPS or referred to 1000 CPS.

Insulation Resistance:	Temperature	1R x mfd	Maximum IR Requirements
	25° C	50,000	15,000 megohms
	85° C	1,000	6,000 "
	125° C	50	300 "

Pyramid Mylar capacitors are subject to the following tests:

Test Voltage—Mylar capacitors shall withstand 200% of rated D.C. voltage for 1 minute at 25° C.

Life Test—Mylar capacitors shall withstand an accelerated life test of 250 hours with 140% of the voltage rating for the test temperature. 1 failure out of 12 is permitted.

Humidity Test—Mylar capacitors shall meet the humidity requirements of MIL-C-91A specifications.

Complete engineering data and prices for Pyramid Mylar and Tantalum Capacitors may be obtained from Pyramid Research and Development Department.

WESCON BOOTH 1401

•DU PONT REGISTERED TRADEMARK

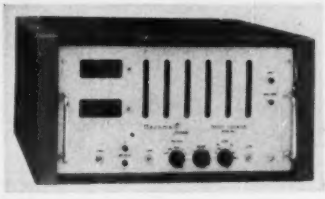
CAPACITORS—RECTIFIERS
FOR ORIGINAL EQUIPMENT—
FOR REPLACEMENT

PYRAMID ELECTRIC CO.
NORTH BERGEN, N. J.

EXPORT: 458 Broadway, N.Y. 13, N.Y. • CANADA: Wm. Cohen, Ltd.—7000 Park Ave., Montreal

trical characteristics: input voltage, 15 v 400 cycles (stator); output voltage, 13.7 v (rotor); phase shift (stator as primary), 20.5 deg; output voltage, 13.7 v (compensator); Z_{rr}, 234 + j 596; Z_{rr}, 244 + j 548; Z compensator 237 + j 553; maximum null voltage, 1 mv/v.

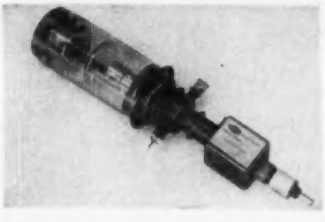
CIRCLE NO. 244 READER SERVICE CARD



Preset Counters single or dual

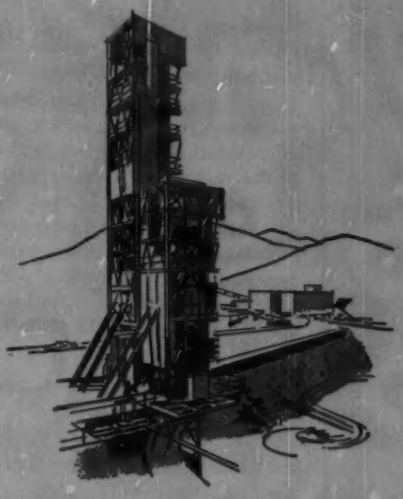
BECKMAN/BERKELEY, 2200 Wright Ave., Richmond, Calif. The 7400 series deliver pulsed or steady state output signals at either one or two preselected number of counts. Eight distinct output patterns are available to perform various functions in digital logic systems. Output signals are 50 v 30 μsec pulses, 50 v 50 ms pulses and a fast 50-v change in d-c output level. All electrical outputs occur within 50 μsec of the time the preset number is reached. The instruments also generate output signals in the form of dpdt relay transfers rated at 5 amperes.

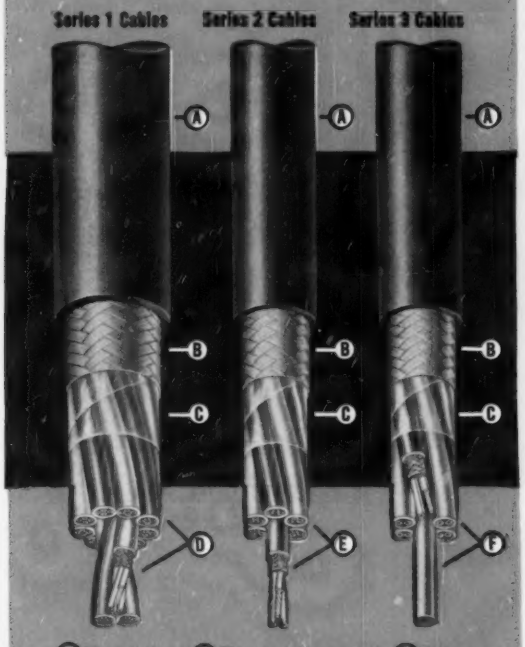
CIRCLE NO. 245 READER SERVICE CARD



High-Vacuum Pump self-gaging

VARIAN ASSOCIATES, 611 Hansen Way, Palo Alto, Calif. The VacIon pump is an electronically operated gas discharge device with no moving parts or pumping fluid. Models are available with capacities from one liter per sec to 100,000 liters per sec. They clean vacuum beyond 10^{-9} mm Hg and operate multi-decade strip chart recorders. Operating principle of the pumps is





Ⓐ Vinyl jacket Ⓑ Tinned copper shield Ⓒ Mylar tape wrap Ⓓ 12 color coded groups. Each group: 2, 3, or 4 color coded conductors, shielded, jacketed Ⓔ color coded groups. Each group: 2, 3, or 4 color coded conductors, shielded, jacketed Ⓕ 6 color coded pairs cabled around vinyl filler. Each pair coded thermocouple wire, shielded, jacketed.

THE WILLIAM BRAND & CO., INCORPORATED

WILLIMANTIC 3 TURBO BRAND CONNECTICUT

electrical and electronic wires and cables • harnesses and cable assemblies • plastic and coated insulating tubings • identification markers

BRAND TEAMS WITH MARTIN TO MEET TOUGH CABLE SPECS FOR TITAN TEST FIRING

Absolute reliability! A must for the control and telemetering cables used for transmitting high fidelity signals during missile development static test firings. The data collected must be absolutely accurate if it is to establish the validity of the missile design or become the basis for necessary changes. The Martin Company found the solution to these tough signal transmission problems with three special multiconductor cables produced by Brand. Here's how Brand teamed with Martin to meet these new and difficult cable specifications:

Series 1 Instrumentation Cables: — Problem: Cables to have approximately the same uniform diameter with varying numbers of conductors, to fit into standard connectors. To meet critical electrical requirements, especially low loss characteristics. **Solution:** Use color coded Turbolene (polyethylene type) insulation to meet electrical and physical requirements. Give twisted pairs a uniform circular cross section by using specially developed **extruded** Turbolene fillers.

Series 2 Instrumentation Cables: — Problem: Cables to operate up to 100°C and to have approximately the same finished diameter with varying numbers of conductors. **Solution:** Use insulated wires meeting MIL-W-16878, manufactured with Turbo 540 vinyl compound and nylon jacketed. Carefully control lay lengths during cablings, and outer jacket wall thicknesses.

Series 3 Thermocouple Cables: — Problem: Non-hygroscopic, funginert cables, each six thermocouple pairs. **Solution:** Develop extrusion and cabling techniques to economically process hard and springy chromel, alumel, iron, constantan and copper conductors. Use Turbo 540 vinyl compound as primary insulation and as filler.

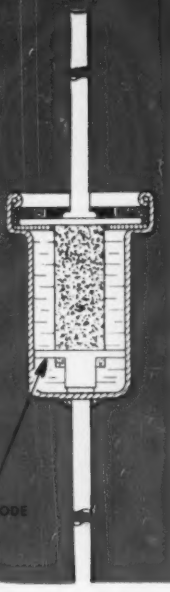
There were additional problems common to all series. (1) A vinyl jacketing material for the shielded groups to operate at both high and low temperatures, and to have an IR value comparable to those found in vinyl primary insulation. Turbo 570, a new custom formulation, was developed to meet these requirements. (2) All groups of conductors laid in a predetermined pattern to facilitate termination. The cables were manufactured on large two-bay planetary cablers to control positioning. (3) Long, unbroken, uniform lengths — all control and instrumentation circuitry is carried in steel reinforced concrete tunnels between test stands and blockhouse as shown in the above drawing.

Whether in missiles, aircraft, business machines or electronics — Turbo cables are custom engineered for specific operating conditions; manufactured by quality-conscious technicians; tested foot by foot for specification compliance. We invite you to call on our extensive engineering experience to solve your cable problems. No obligation, of course. Send your specifications or requirements.

Be sure and visit the Brand exhibit at WESCON Show— Booth 1119

NEW FANSTEEL "PP" TYPE Tantalum Capacitor

NOW VIBRATION and SHOCK RESISTANT



At No Increase In Price!

Now, with more rugged construction and specially designed anode base support, the New Fansteel Type "PP" Capacitor is especially adaptable for circuitry where exceptional resistance to vibration and shock is required . . . *at no increase in price.* The new "PP" also has better low temperature characteristics.

The Fansteel Type "PP" retains all its high performance features—outstanding frequency stability, negligible electrical leakage—proved in countless applications demanding unquestionable reliability and dependability. It occupies minimum space, and yet provides extremely high capacity ratings for its size.

CL44's & CL45's NOW CONFORM TO MIL-C-3965B

Get complete information today. Write for Bulletin 6.100

See us at Booth 222
WESCON SHOW

FANSTEEL RELIABILITY

C595A

FANSTEEL METALLURGICAL CORPORATION North Chicago, Ill., U. S. A.

based on the chemically reactive characteristics of titanium, which combines with ionized gases in the pumping chamber. An extremely vigorous pumping action results. Illustrated on p 140 is a typical application as a built-in feature of a neutron generator. Continuous unattended pumping assures the permanent high vacuum conditions necessary for optimum performance of electronic vacuum tubes.

CIRCLE NO. 246 READER SERVICE CARD

TWT Amplifier for airborne use

HUGGINS LABORATORIES, 999 East Arques, Sunnyvale, Calif. Type HA-27 electrostatically focused twt amplifier has a frequency range of 1.0 to 2.0 kmc; signal gain, 30 db (min.); saturated power output, 5 dbm (min.); capsule length, 15¼ in.; net weight, 1.5 lb. Since the tube uses no magnetic focusing fields, it is relatively insensitive to changes in ambient temperature.

CIRCLE NO. 247 READER SERVICE CARD

Programming Systems meet Mil Specs

VIRGINIA ELECTRONICS CO. INC., River Road and B&O Railroad, Washington 16, D. C. Circuit programming systems feature modular construction which permits expansion of the system in two directions, offering from 110 to 5,500 contacts in a multiplicity of contact configurations. Interchangeability of the connectors themselves permits three different types of removeable programming boards: (a) patchcord programming, (b) solder contacts for permanent programming and (c) multiple contact patchcord programming either vertically or horizontally as well as panel mounted patchboards. Single and multiple contact patchcords and multiple contact plug-in modules are available.

CIRCLE NO. 248 READER SERVICE CARD

Hydrogen Thyratrons miniaturized

EDGERTON, GERMESHAUSEN & GRIER, INC., 160 Brookline Ave., Boston, Mass. The HY-1 and 632 are ceramic-metal hydrogen thyratron tubes. Together with the 1802 they will handle all switching power requirements up to 20 megawatts. The HY-1 is 2⅞ by 4⅝ in. overall; is rated 5 megawatts, 20 kv, 500 amperes peak and a P_s factor of 10 × 10⁶. The 632 is 1.1 by 1.6 in. overall; is rated 67.5 kw, 3 kv, 45 amperes peak and a P_s factor of 1 × 10⁶.

CIRCLE NO. 249 READER SERVICE CARD

Trimmer Pots five terminals

DALE PRODUCTS, INC., Columbus, Neb. Extended selection of five-terminal Dale T-Pots meet humidity requirements of MIL specs for trimmer potentiometers. Styles include wire leads, insulated wire leads, p-c base leads and hook type solder lug terminals. Type 750 ratings are 2 w, 10 ohms to 30 kilohms, 17 ±2 revs screw adjustment, 2 grams weight and 0.054 cu in. volume. Type 1000 ratings are 2.5 w, 10 ohms to 50 kilohms, 25 ±2 revs screw adjustment, 2.5 grams and 0.068 cu in. Both are ±5 percent tolerance.

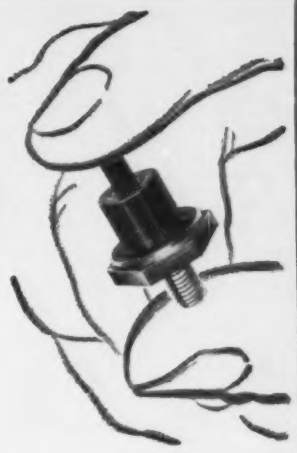
CIRCLE NO. 250 READER SERVICE CARD

Shielding saves space, weight

BELDEN MFG. CO., 4647 W. Van Buren St., Chicago 44, Ill. Beldfoil permits the use of completely isolated, individually shielded and jacketed conductor pairs in a lightweight, small diameter cable. Space and weight savings are obtained by the combining of the conductivity of aluminum foil with the high di-

FANSTEEL TESTED AND PROVEN RELIABILITY

Fansteel (Type 6A) 1N Series



22 AMP.

Silicon Power Rectifier

Fansteel 6A Silicon Rectifiers undergo the most complete and rigid testing ever devised to *prove* reliability . . . to assure performance that matches or exceeds expected service. Painstaking thoroughness, and care . . . 100% testing . . . and exacting production methods in contamination-free surroundings assure unquestionable reliability in every Fansteel 6A Rectifier.

The highly stable 6A carries a full 22 amp. load in half-wave circuits; up to 66 amps in bridges. It has peak reverse voltages from 50 to 400 v. in 50-volt multiples. It operates at ambients up to 165°C.—unaffected by storage temperatures from −65 to +200°C.

Rugged, compact, hermetically-sealed construction . . . exceptional shock and vibration resistance. The 6A can be mounted in any position.

Ask for Bulletin 6.304.

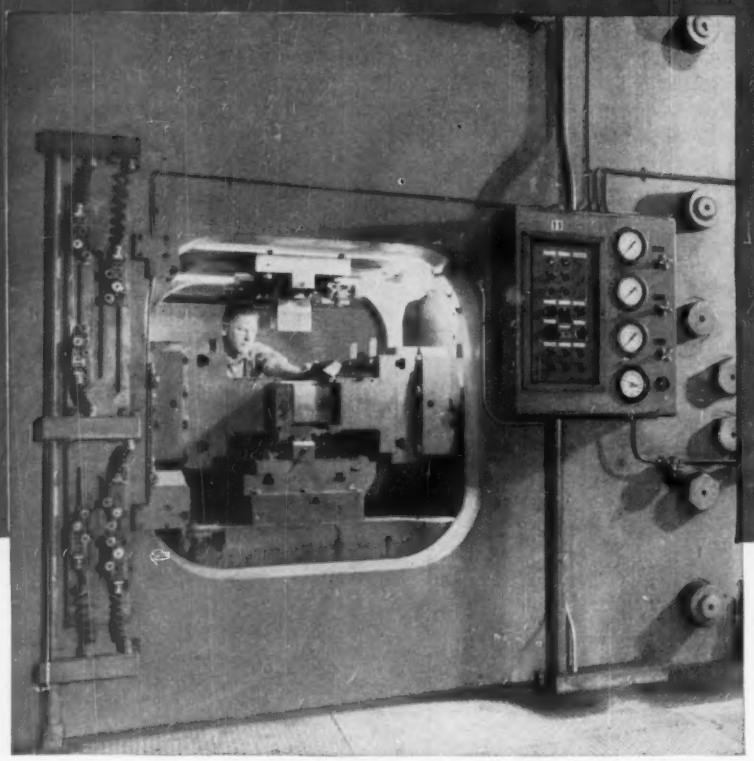
Visit us at Booth 222 WESCON SHOW

FANSTEEL RELIABILITY

FANSTEEL METALLURGICAL CORPORATION North Chicago, Ill., U.S.A.

TANTALUM . . .

Reliable Capacitors Start With Reliable Tantalum



Capacitor Grade Tantalum metal powder is compacted in this giant 3000-ton, 4-way action hydraulic press (the largest of its kind ever built) in the Fansteel North Chicago plant.

IN PRESENT DAY electronics, reliability cannot be overstressed. To attain high reliability, basic materials in components must not only be of the highest quality; they must be designed for their particular purposes. Certainly this is true of tantalum capacitors.

In the early development of tantalum capacitors, Fansteel found out that a special grade of tantalum is necessary. Other leading capacitor manufacturers followed suit, and used only Fansteel Capacitor Grade Tantalum in the form of foil, sheet, wire and sintered anodes. They rely completely on the quality of Fansteel Capacitor Grade—quality achieved through the experience of 37 years of tantalum pioneering and research.

Capacitor Grade Tantalum grew up at Fansteel—right along with the tantalum capacitor and tantalum metal itself. It is a premium grade produced under the strictest laboratory standards to insure uniformity of its improved properties. It was developed especially for capacitor applications. Fansteel research continues to work to make Capacitor Grade an even better tantalum, and Fansteel manufacturing facilities and ore resources assure continuous supply for your expanding needs.

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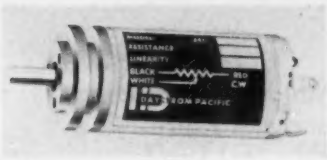

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DAYSTROM PACIFIC, a division of Daystrom, Inc., 9320 Lincoln Blvd., Los Angeles 45, Calif. Thimble-size pots capable of withstanding shock and vibration to 20 g's are designed for performance under severe environmental conditions encountered in aircraft and missile applications and also where maximum reliability and minimum space are specified requirements. Single and multiple-turn, high temperature, and rectilinear trimming pots are available. Illustrated is the one-half in. diameter series 341.

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digital systems

DYMEC, INC., 395 Page Mill Rd., Palo Alto, Calif. Model DY-5234 universal programmed test set is a typical system assembled from standard Dymec instruments. It automatically measures d-c or a-c voltages or frequencies of up to 15 assorted input signals. Input signal reading is visually compared with preset tolerances. D-c voltages to 1,000 v are measured within 0.2 percent and a-c voltages within 0.5 percent. Building blocks include DY-2500 computing digital indicator, DY-2507 dual preset counter, DY-2542 tape punch sets, DY-2210, voltage to frequency converter and integrator, DY-2504A photoelectric tachometer, DY-2508A digital clock, DY-2538 programmed digital comparator, DY-2513A counter scanner,

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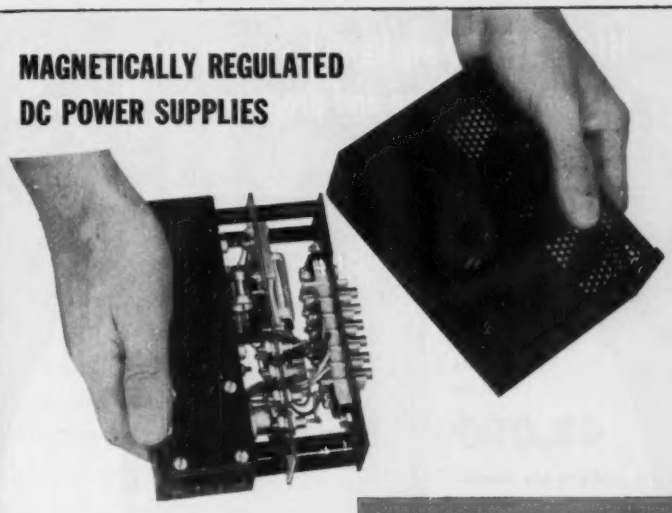

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D-1358	115 volts/400 cps	6 VDC	.25 amps	6.38	2.09	5.0
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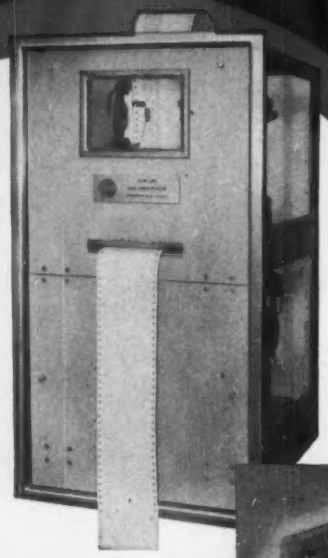

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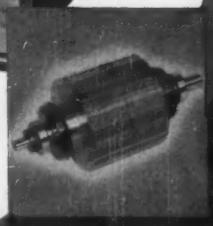

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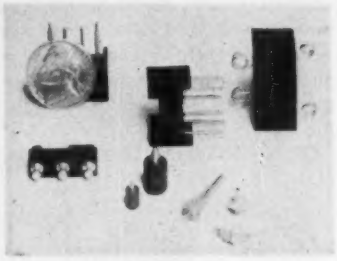

Molded Terminals and hardware

LERCO ELECTRONICS, INC., 501 S. Varney St., Burbank, Calif., introduces a line of stock and custom molded parts. Included are four subminiature feed-through terminals with molded threadings that permit quick installation without special tooling, swaging or intricate assembly operations. Primary applications will be in small motors, resolvers, potentiometers and other radial assemblies.
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MENLO PARK ENGINEERING, 711 Hamilton Ave., Menlo Park, Calif. A packaged p-m focused backward wave oscillator which covers the X band provides a minimum of 1 mw power output. Compared to solenoid focused equipment, this unit weighs 50 percent less. Other advantages include far less power consumption (up to 75 percent reduction) and operational ease.
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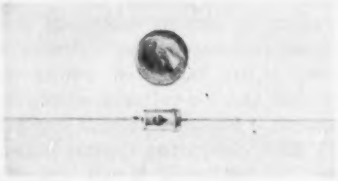

Wirewound Resistor bobbinless

GENERAL TRANSISTOR CORP., 91-27 138th Place, Jamaica 35, N. Y. GTR-10 bobbinless precision wirewound

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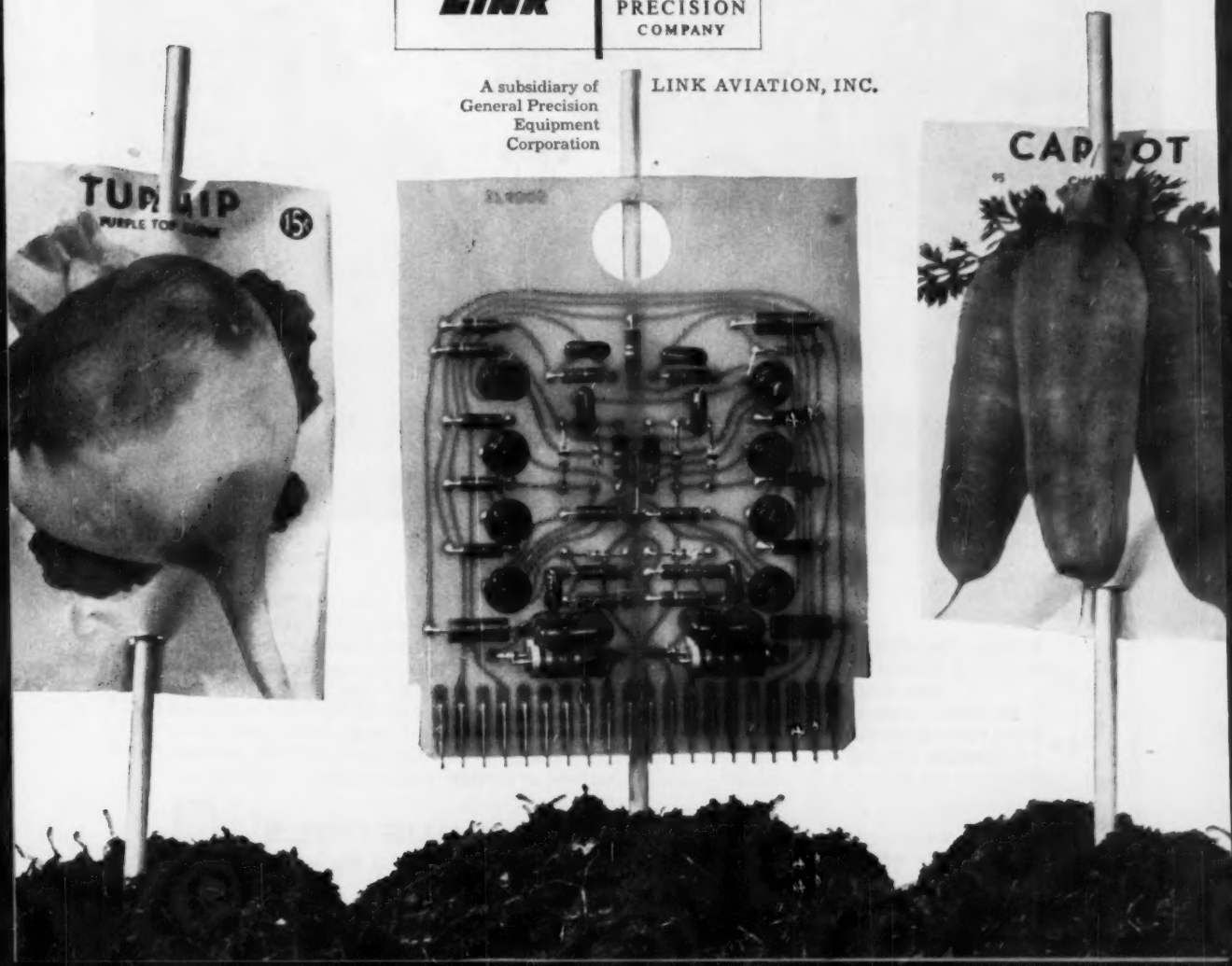

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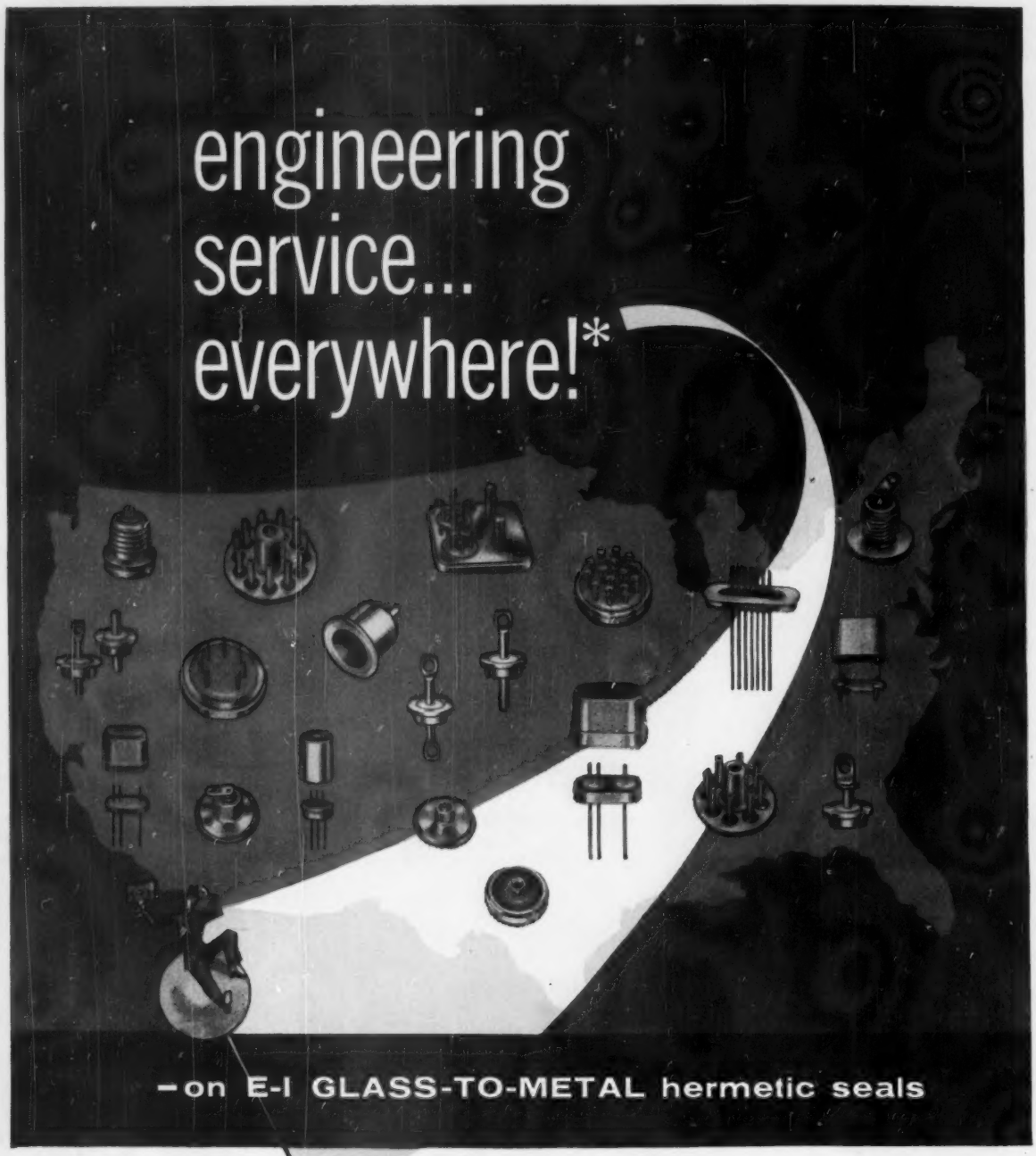

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resistor is available in temperature coefficients of resistance as low as ±2 ppm/deg C and tolerances of 0.01 percent. It exceeds MIL-R-93B and MIL-R-9444 specifications. Its stability and ability to withstand shock, vibration and adverse environmental conditions make it ideal for computer and military applications. Resistance range is 0.1 ohm to 750 K ohms, power rating ⅓ w, and maximum operating voltage 500 v d-c.

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Laminates self-extinguishing

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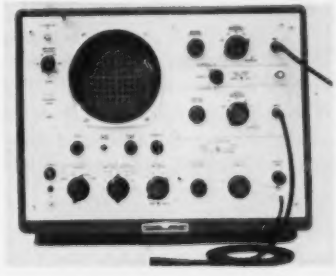

Sampling Scope fast rise time

HEWLETT-PACKARD CO., 275 Page Mill Road, Palo Alto, Calif. Model 185A sampling oscilloscope provides a clear and steady display of pulses requiring resolution up to 500 mc. Presentation is on a large, 5-in. crt face, and no optical magnification is needed. Calibrated sweeps are compatible with the bandwidth of the scope and vary from 1 milli-μsec/cm to 100 milliμsec/cm. Rise time is approximately 0.7 milliμsec. A sweep delay control and magnifier provide a convenient means for syn-

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TEMPERATURE CONTROL EXPERIENCE

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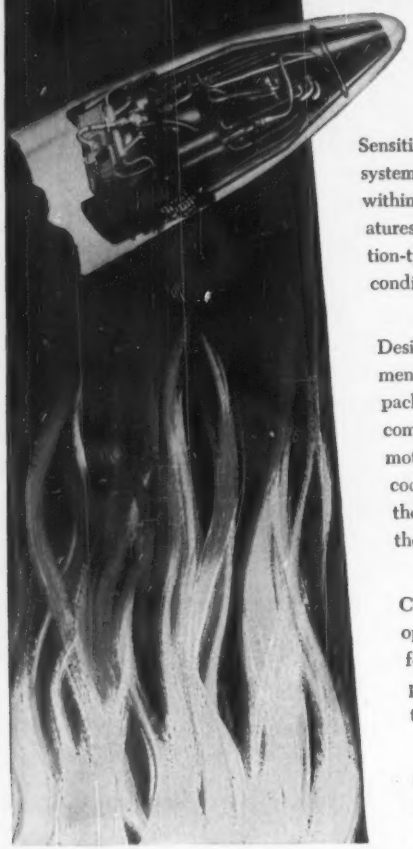

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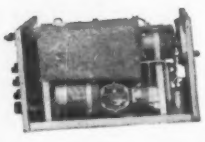

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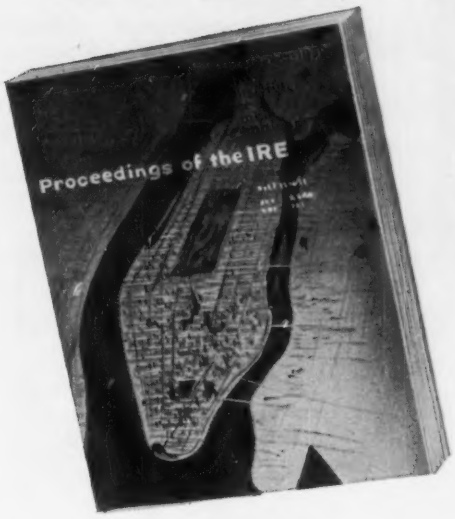

The turning point in the practical application of infrared to military problems was during World War II when the Allies discovered the German Army was using infrared for secret signaling between infantry troops, for the surveillance of Russian tanks supposedly secure in the darkness, and for the detection of Allied night bombers which confused radars by the use of chaff. The turning point for the commercial application of infrared came about the same time when the American synthetic rubber program required rapid analysis of the C_4 fraction in butadiene production. Since this could best be achieved through infrared spectroscopy, commercial infrared spectrophotometers for chemical analysis began to appear in 1943.

Today, despite great advancements in the application of infrared to military and commercial uses, it appears to be only on the threshold of its full realization. That's what makes infrared such an exciting and challenging topic to investigate.

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This comprehensive review of a rapidly growing science—infrared—is only one of the many services offered members of the IRE. Non-members of the Institute of Radio Engineers, however, are invited to reserve a copy of this vital issue by returning the coupon below, today.

PARTIAL CONTENTS OF THIS INFRARED ISSUE:

Preface, by Dr. Arthur R. Laufer.

Infrared, a New Frontier of Physics and Technology, by Dr. Stanley S. Ballard.

A History of Infrared, by Dr. Warren N. Arnquist and Dr. E. Scott Barr.

The Physics of Infrared, by Dr. Lewis E. Larmore.

The Infrared System, by Dr. Sidney Passman.

Applications, by Dr. Paul J. Ovrebo and Dr. R. Bowling Barnes.

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Krohn-Hite *power supplies are used*

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MAIN DC OUTPUT: zero to 500 volts, continuously adjustable, at zero to 500 milliamperes.

REGULATION: less than 0.001% plus 0.002 volt from no load to full load.

LINE STABILIZATION: less than 0.003% plus 0.003 volt, for 10% change.

OUTPUT IMPEDANCE: DC — less than (0.005 + 0.00002 × output volts) ohm; AC — less than 0.05 ohm plus 0.1 michrohenry.

RIPPLE: less than 0.1 millivolt rms.

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DC HEATER OUTPUTS: 5 to 12.6 volts, adjustable, at zero to 2.5 amperes.

AC HEATER OUTPUTS: two, each 6.3 volts at 10 amperes.

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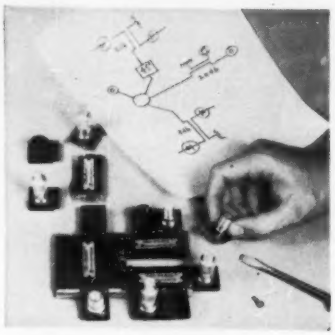

Microwave Modules for quick assembly

SANDERS ASSOCIATES, INC., Nashua, N. H. A series of modular strip transmission line components can be assembled in minutes to produce complete circuits for 2-4 kmc operation. Tri-Plate modules permit quick, easy laboratory breadboarding of mixers, duplexers, modulators, and other circuits encountered in radar, data link, and microwave computer development.

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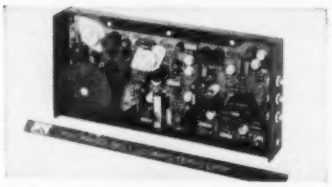

D-C Amplifiers solid-state

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Standard products of the Hamilton Watch Company, Hathaway Instrument Division, include a full line of the highest quality measuring, testing and control instruments. Through a continuing program of research and development, Hamilton is engaged in the creation of vital new concepts in instrumentation...emphasizing the solution of special problems in electronics and electromechanical assemblies.

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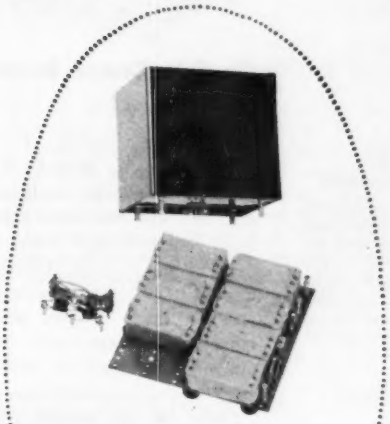


HAMILTON 55906 TUNING FORK FREQUENCY STANDARD

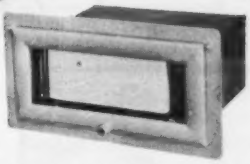
A tuning fork, oven and associated circuitry assembly for ultra-high performance standards. Provides a stable, accurate source supplying the requirements of 200 to 6400 cycles per second as a fundamental frequency.

HAMILTON C6 OSCILLOGRAPH CAMERA

Adaptable to any type of oscilloscope having a 5" tube—provides a 6-inch wide continuous photographic record of phenomena displayed on the scope.

HAMILTON 52790 TUNING FORK FREQUENCY STANDARD

Its basic design makes it suitable as a modular component to provide a stable, accurate source supplying the requirements of 400 cycles as a fundamental frequency. Invaluable wherever instruments are sensitive to power frequency.



HAMILTON OPERATIONS RECORDER

This digital-analog recorder monitors multiple sequences or events. The electro-sensitive record for instantaneous viewing is produced by self-contained transistorized sensing circuits powered from an internal battery.

WESCON SHOW

Hamilton Representatives are available at The Clift Hotel, Penthouse

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HATHAWAY INSTRUMENT DIVISION
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from
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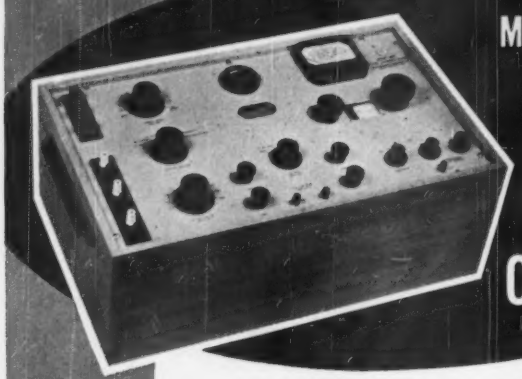

Measures Precise AC-DC Voltage & Current

Model 1605 $2450.

A Self-Contained Laboratory Standard Facility

The Model 1605 AC-DC Calibration/Transfer Standard is a multi-function instrument capable of measuring AC and DC voltage and current up to 1500 volts and 15 amperes. It includes a precision four-digit readout potentiometer, laboratory standard cell, precision voltage multipliers, precision shunts hermetically sealed in oil, light beam galvanometer, AC monitoring meter, thermal converter and all necessary batteries and controls. DC measurements utilize the potentiometer or the potentiometer in conjunction with the voltage multipliers or shunts. For AC measurements the potentiometer and/or multiplier-shunt arrangement is used with the compensated AC-DC transfer element.

LIMIT OF ERROR

DC: 0.05% with correction factors; 0.1% direct reading.

AC: 0.065% with correction factors; 0.13% direct reading.
(AC accuracies are to 50 kc on most ranges.)

For Owners of the RFL Model 829 AC-DC Instrument Calibration Standard

The Model 1605 may be used in conjunction with the Model 829 to calibrate instruments having greater accuracy requirements than that supplied by the Model 829 alone. The Model 1605 may also be used to calibrate the Model 829. The 829/1605 combination provides a calibration system which will handle your requirements, for current and voltage measurements to an accuracy of better than 0.1%, from DC to 400 cps.

Performance is rigidly guaranteed. Price is net, f.o.b. Boonton, N.J. and subject to change without notice.

SEND FOR TECH. DATA

For additional information, including application data, write or phone DE 4-3100. Demonstrations available by local representatives.

RFL Radio Frequency LABORATORIES, INC. Boonton, New Jersey, U.S.A.

band, accurate amplification where reliability is of prime importance. Differential types for use in the data reduction field have input impedances up to 10,000 megohms, noise in the μv range and a common mode rejection of 120 db at d-c. Operational types provide impedance matching and signal inversion in data handling systems. Potentiometric types are used as buffering devices to isolate the source of the measurement from the measuring device.

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Trimmer Pot for p-c use

SERVOTROL INC., 10130 W. Pacific Ave., Franklin Park, Ill. Type TPC is a microminiature trimmer, specifically designed for printed circuit installation, being about $\frac{1}{4}$ in. thick and 1 in. long. All the features of sealed high temperature plastic to meet severe environmental conditions are standard. A 37-turn lead screw provides the fine adjustment.

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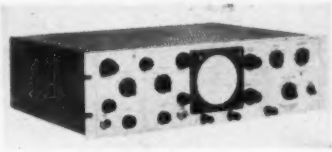

Double Beam Scope two-gun crt

THE SCOPES CO., INC., P. O. Box 56, Monsey, N. Y. Model D31R double beam oscilloscope includes a dual-gun crt and has individual brightness controls and twin amplifiers d-c to 6 mc, −3 db. Panel height is $7\frac{3}{4}$ in. Unit has automatic sync, trigger level control and built-in time and voltage calibrators. It is claimed to provide double beam facilities at single beam cost.

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Instruments for lab and plant

GENERAL RADIO CO., West Concord, Mass. New instruments include Type 1554-A battery-operated sound and vibration analyzer. It is a tunable voltmeter with adjustable

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bandwidth for narrow, ⅓ octave and all-pass and will measure single-frequency and continuous (noise) components of spectrum. Range is 2.5 to 25,000 cps with a 10:1 span on each range. Type 1521-A is a transistorized graphic level recorder operating between 20 cps and 200 kc; type 1650-A, an impedance bridge with a transistor generator and detector; type 1305-A, an l-f polyphase oscillator with 0.01 to 1,000 cps output, direct-reading output-voltage meter, log frequency scale and output step attenuator for reduction of output level in 20 20-db steps. Type 1632-A is an inductance bridge with resolution to 6 significant figures and full-scale ranges from 1,111 μh to 1,111 h inductance and 1,111 μmhos to 1,111 mhos conductance.

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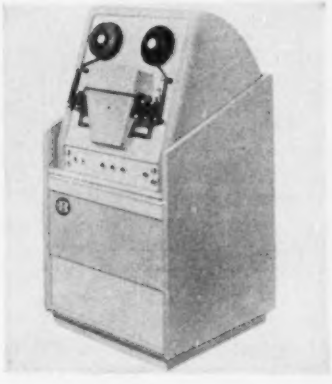

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BURROUGHS CORP., Electro Data Division, 460 Sierra Madre Villa, Pasadena, Calif. Model 220 Photoreader automatically transmits data and instructions via perforated paper tape to digital computer and control systems at the rate of 1,000 characters per sec. Unit may be adapted to any standard-width five-to-eight-level code commercial tape. Despite its rapid reading rate, the unit will stop on a single character in less than a second.

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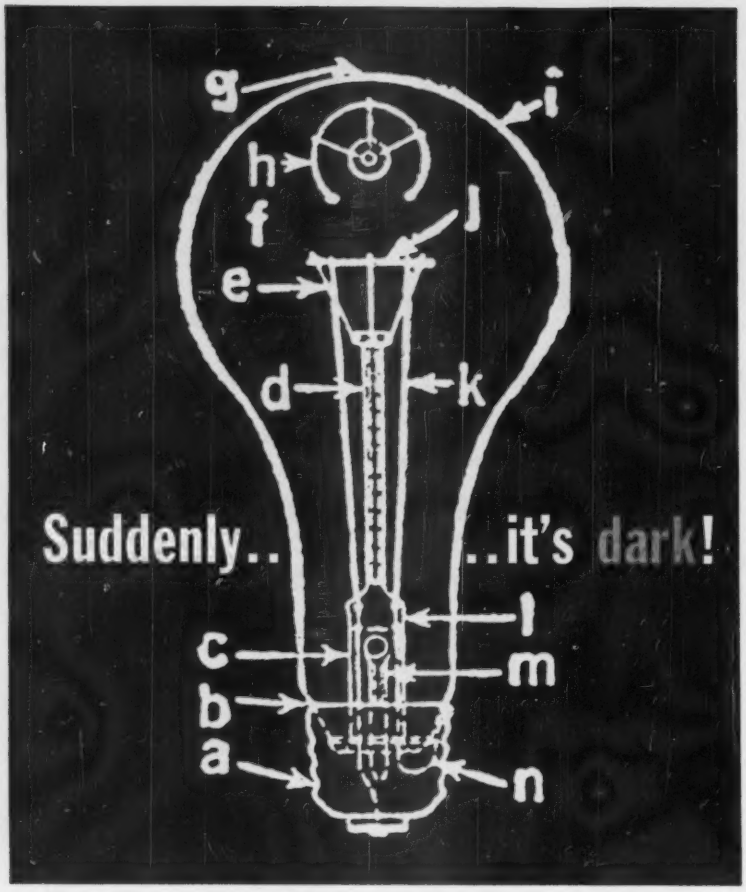

A pretty dark situation, indeed—when a *single* electron tube failure can shut down an equipment or entire production line test facility! Use IERC's new set of a, b, c's to help you get improved electronic equipment reliability. **a.** The practice of replacing tube failures in manner and attitude like that of replacing a light bulb is neither protection nor cure against a continuing high rate of electron tube failures! **b.** Downtime, labor replacement costs often add up to 10 times the tube cost! **c.** You can actually increase tube life up to 12 times by specifying and using IERC Heat-dissipating Electron Tube Shields! The full facts, in the form of **d.** complete product literature, **e.** test reports, **f.** engineering data and **g.** tube shield application guides, especially prepared to help you "see the light," are available on request—write today!

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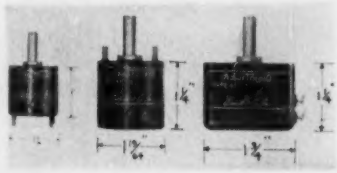

Adjustoroids pot, stud mounts

BURNELL & Co., 10 Pelham Parkway, Pelham, N. Y. Pot and stud mounting types of Adjustoroids are designed for accessibility of slotted controls. The stud mount is particularly designed for p-c use in high acceleration, shock and vibration environments. Both types are hermetically sealed to meet MIL E 153052, or encapsulated in any sizes and shapes to fit special applications.

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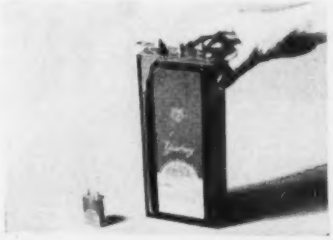

Storage Battery silver-zinc cell

YARDNEY ELECTRIC CORP., 40-50 Leonard St., New York, N. Y. The PM200 Silvercel, a 4-lb, 5-oz battery, can provide outputs of 80 w-hr per lb. It offers a shelf life up to 3 yr, wet stand life more than 2 months, fast activation and re-

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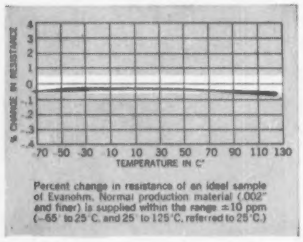

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cyclability (more than 5 cycles). It has an operational temperature range of +165 F to 0 F—down to below −65 F with heaters—and a charge retention of up to 95 percent after one month's activated stand. At a fixed load, and with temperature limits within ±10 F, plateau voltage regulation is within ±2 percent.

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KESTER SOLDER CO., 4201 Wrightwood Ave., Chicago 39, Ill. Latest developments in Solderforms (preformed solder and flux combinations) contribute to the growth of various electronic products. Today Solderforms are vitally important in the semiconductor field, being widely used in transistors and germanium diodes.

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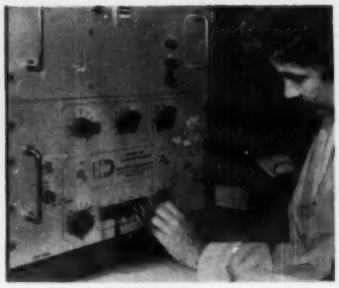
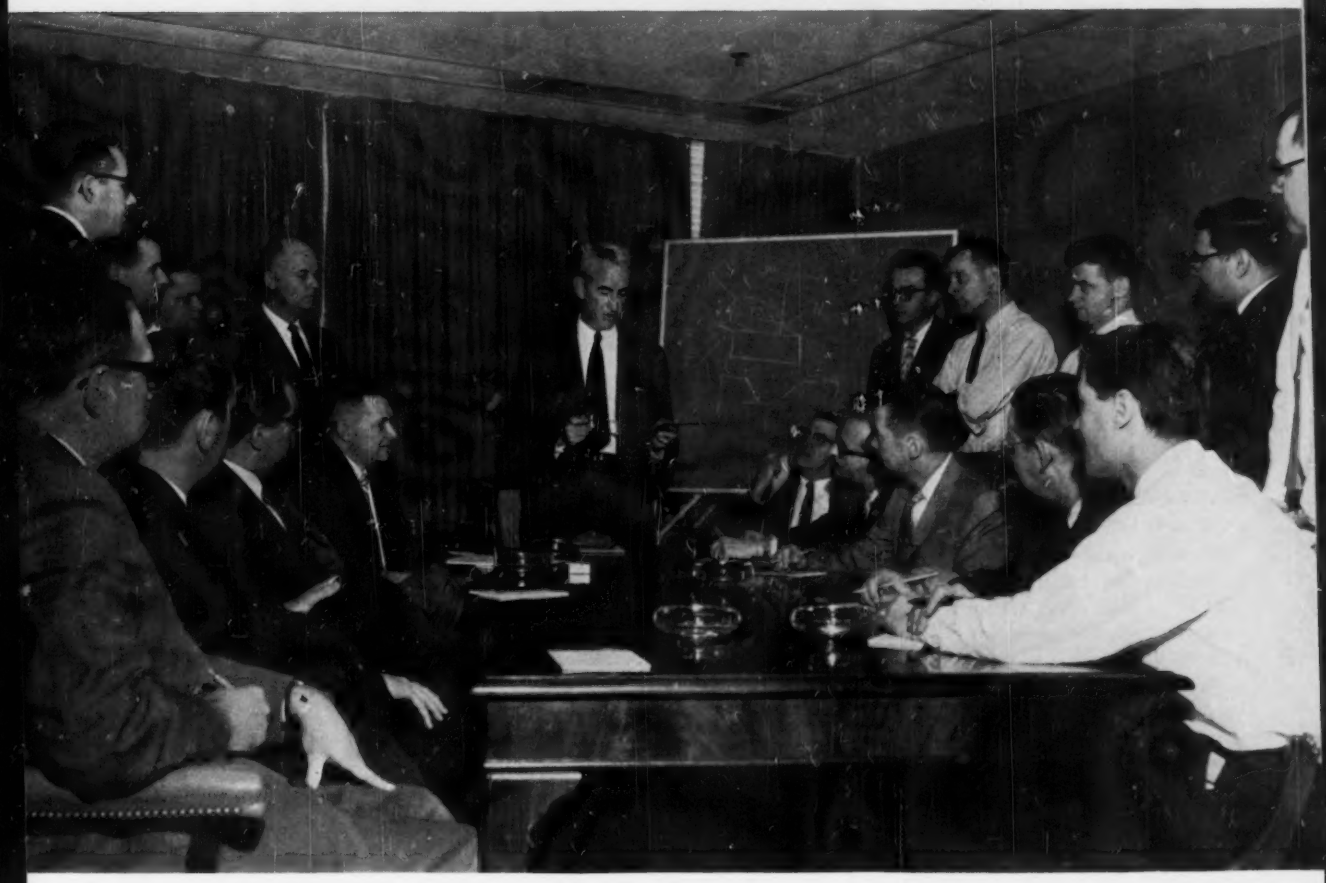


A-C/D-C Calibrators high accuracy

WESTON INSTRUMENTS DIV., Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N. J. Model 60 series a-c and d-c calibration consoles provide power source, circuitry and control for calibration of military, aircraft, industrial and laboratory instruments. Accuracy is 0.05 percent at temperatures of 40 F to 100 F. Calibration speed is reported 3 times as fast in time and 6 times as fast in manhours over conventional equipment. Simplified switching networks permit nonskilled workers to operate the consoles. They measure 30¾ in. high by 21½ in. wide and 19½ in. and can be removed from cabinets for mounting in 19-in. rack panels. Each operates from 60-cps, 110-120

Editorial Conference: Friday 9:30 AM



Bill MacDonald, 33 years an Editor, Feeds a Growing Boy

Electronics, like a growing boy, has a voracious appetite – an appetite for information about technical developments, new markets, business potentials . . .

electronics magazine has the job of feeding information to the industry in a balanced editorial diet so that the quality and quantity of editorial will more than meet industry requirements.

Editor W. W. MacDonald inspires respect from his 26-man editorial staff, and justly so. Mac has been, successively, an Associate Editor, Executive Editor and then Editor of *electronics*. Before joining *electronics* he had been Managing Editor of "Electrical Merchandising" and Editor of "Radio Retailing." A senior member of the Institute of Radio Engineers, he has devoted 33 years to editing McGraw-Hill publications.

Mac is responsible for *electronics* editorial. True, he has far more assistance from his highly trained, professionally mature staff than do most business publication editors. Fifteen members draw upon direct engineering experience in the electronics field. Four editors gained electronics experience in the armed services. Four others came to *electronics* with backgrounds in journalism, finance, and marketing. The balance of the staff comprise the Art Director and his assistants.

But the Editor of *electronics* is a perfectionist and never satisfied. He is constantly raising the standards by researching his readers, going into the field, sounding out his staff.

And what does Mac's editorial contribution mean?

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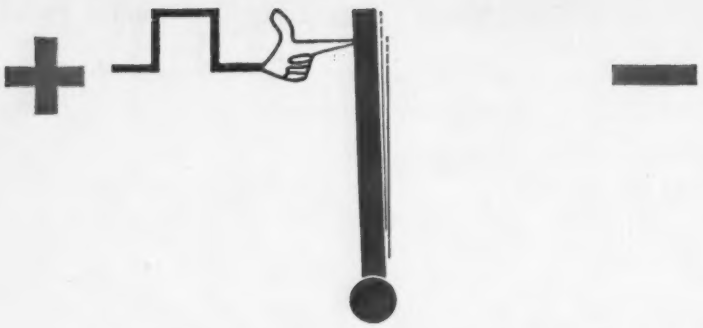

How to trip a relay*

WITH A WEE PULSE

The technique of operating relays by direct application of pulses is nowhere near as widely used as (we think) it should be. This method lets you keep relay energy consumption and power supply drain down to a bare minimum — particularly if bi-stable polar relays are used. When you combine pulse operation with magnetic latching, no continuous coil current is needed to keep the relay contacts closed. Of course we have an ax to grind in that there are now no less than six* series of Sigma polarized, magnetic latching (Form Z) relays which can operate on single pulses. The newest of these is the subminiature Series 32 — which, when operated in this power-pinching way, could be just what you've been looking for.

Series 32

Here are some of the "high spots" in the technique of transferring the armature from one contact to the other with minimum energy. Ideally, the armature should arrive at the center of the air gap with zero velocity, whereupon the magnetic field can take over. A current pulse that starts out at trip value and decreases linearly to zero as the armature reaches the mid-point could do this (fig. 1), but the inductive relay coil makes such a pulse circuit impossible.

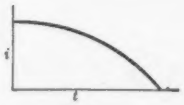

Fig. 1

However, similar waveforms can be approximated by a capacitor-stored pulse discharged into the relay coil. Although there are several fundamentally similar ways of doing this, one circuit (fig. 2) wastes no energy in a resistor and permits the relay to take a round trip operation on a single slug of energy from the source.

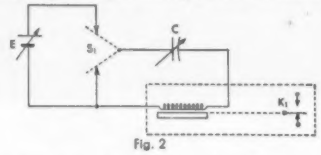

Fig. 2

As you get deeper into this business, it turns out that at least two quantities must be known to apply this method: the "pulse constant" in microjoules per mw. of relay sensitivity, and the "matching constant" in microseconds. A technical paper discussing all of the foregoing in some detail (presented at the recent NARM Conference), pulse application data, Series 32 bulletin, etc. are available on request. Ask for the special "Pulse Packet", handsomely bound in a manilla envelope.

*Sigma Series 6, 7, 32, 61, 72 & 73

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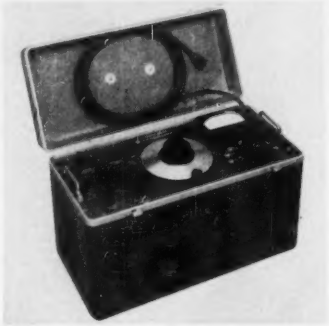

Wave Analyzer portable, compact

TECHNICAL PRODUCTS CO., 6670 Lexington Ave., Los Angeles 38, Calif. TP-670 wave analyzer weighs 28 lb in carrying case. It offers a frequency range from 20-20,000 cps with a selection of two filter band widths, 5 cps and 20 cps. Voltage input is 0.001 v to 150 v for 100 percent meter indication. Input impedance is 100,000 ohms. Power supply is 115/230 v a-c, 50/60 cps.

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ELECTRONIC ASSOCIATES, INC., Long Branch, N. J. All-transistorized PACE TR-10 analog computer is 15 in. wide, 17 in. deep and 24 in. high, but performs 95 percent of mathematical operations an engineer normally requires in normal design calculations. Price is under $4,000 for basic unit of 10 operation amplifiers to under $9,000 for the fully expanded unit.

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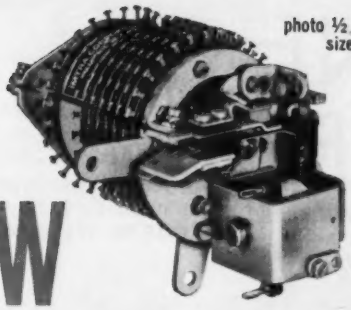

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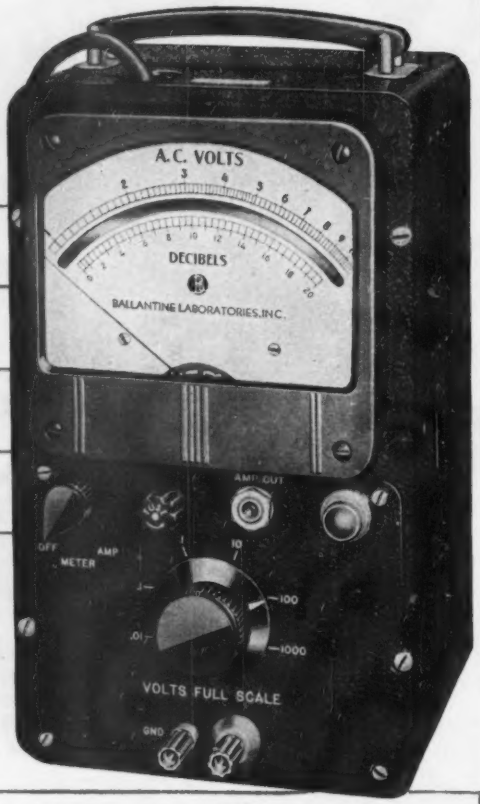

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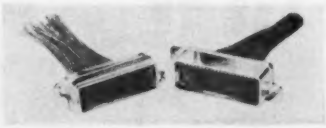

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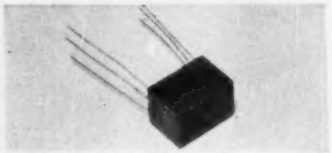

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FERRO-MAGNETICS Co., 989 Commercial St. Palo Alto, Calif. The "F" style pulse transformer was developed to achieve reliability at high speeds and shorter pulses and operation in more stringent environmental conditions. It features a 25 percent reduction in size for a 60 w peak power rating; a standard case better suited to p-c construction; a case whose size and configuration ($\frac{7}{16}$ by $\frac{7}{16}$ by $\frac{9}{16}$ in.) will not vary by more than ± 0.002 in. between any quantity; an internal construction that withstands 700 v hipot.

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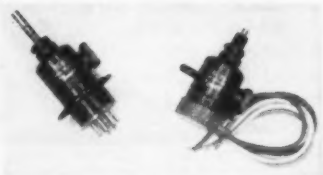

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BENDIX AVIATION CORP., Red Bank Division, Long Branch, N. J. Tube types TE-53 and TE-78 mechanically tuned reflex klystron oscillators operate at 34,000 to 35,600 mc. Design features ceramic insulators, dielectric tuning, waveguide output, and an improved electron gun design to provide stable operating frequency, optimum electronic tuning and power output with low resonator voltage, reduced power input and long operating life.

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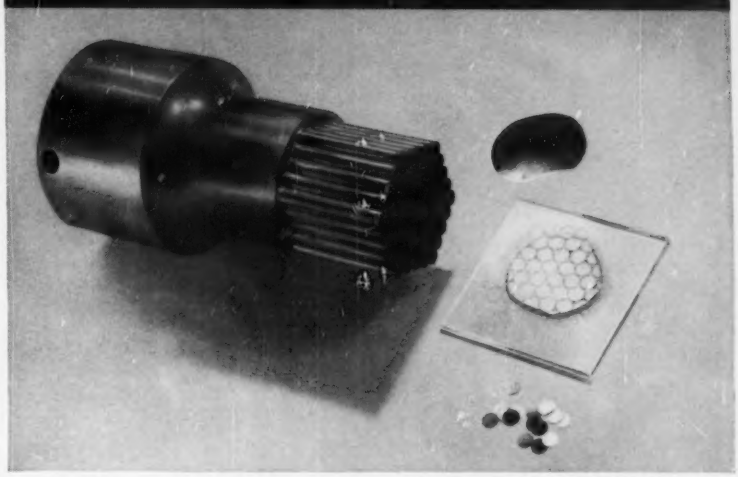

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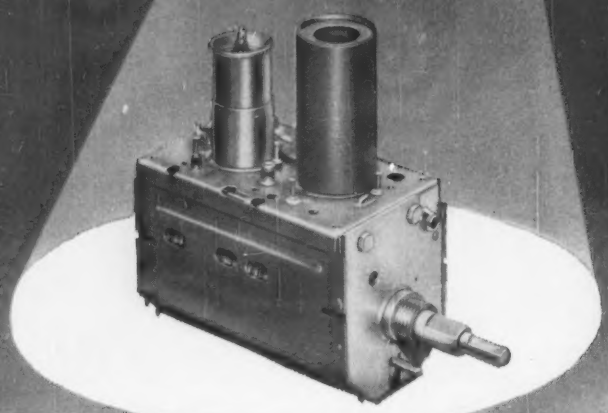

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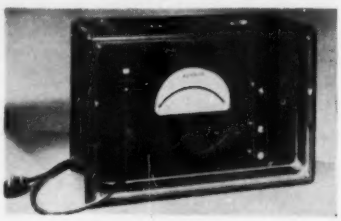

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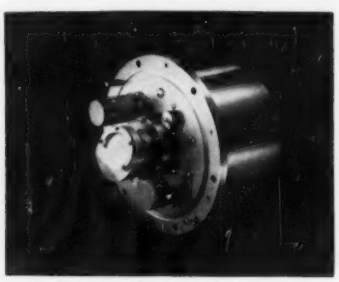

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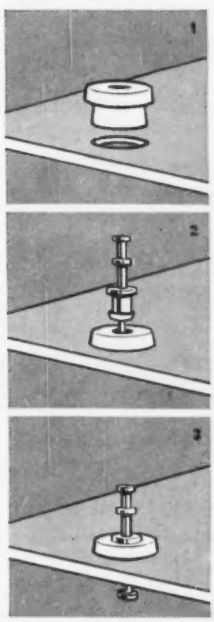

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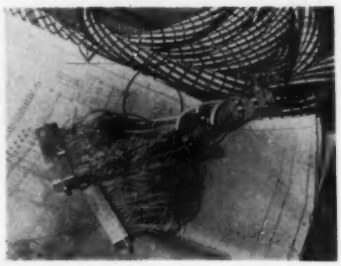

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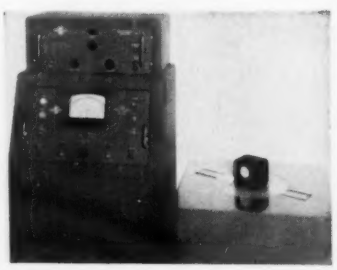
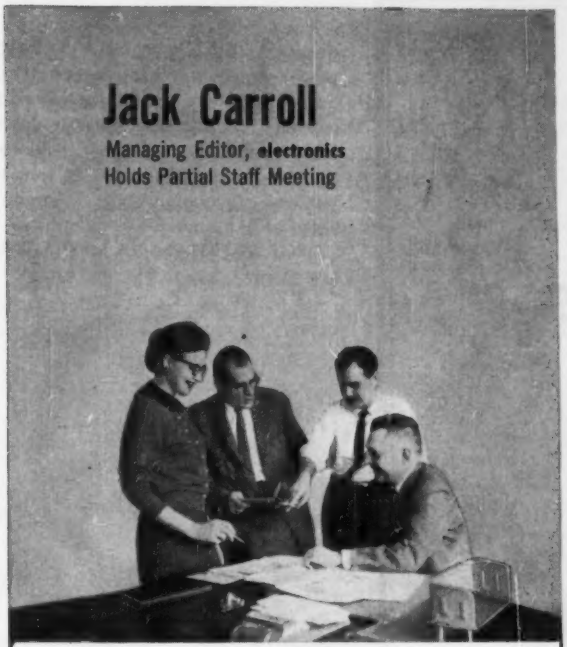


Oscillating Table covers 0.1 to 150 cps

MICRO GEE PRODUCTS, INC., 6319 W. Slauson Ave., Culver City, Calif. Model 60A angular oscillating table is for rapid frequency response testing of rate gyros and angular accelerometers. It holds constant sinusoidal rate as frequency is



Jack Carroll

Managing Editor, **electronics**
Holds Partial Staff Meeting

Resumé:

Carroll, John M., (seated in photo) Lehigh University, BS, Hofstra College, MA in Physics, member several I.R.E. committees. Naval electronics, World War II. Electronics engineering officer during Korean war. Background in engineering derives from experience with the National Bureau of Standards, Naval Research Laboratories, Liberty Aircraft, American Instrument Co. Author of technical books for McGraw-Hill Book Company.

Present Occupation:

Jack Carroll is responsible for "getting-out-the-book" each week within the framework of editorial policy formed by W. W. MacDonald, Editor of **electronics.** Jack is occupied with editorial makeup, with the accuracy of editorial content, with scheduling the workload of a 26-editor staff to provide maximum coverage of technical developments and business information.

References:

Jack is a dedicated man—dedicated to the interests of the readers of **electronics** magazine. His prime goal is to help edit a publication which will be required reading for the important people in the electronics industry—a publication that will fill the needs of design-research, production, management. If you are not receiving the publication that is edited to keep you best informed, if you are not a subscriber, or if your subscription is expiring, fill in the box on the Reader Service Card. Easy to use. Postage is free.

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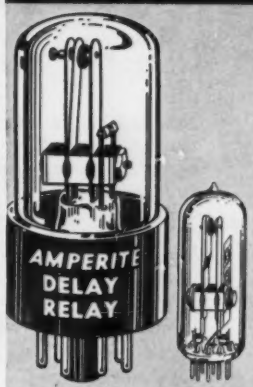

2 to 180 Seconds

Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.

Hermetically sealed. Not affected by altitude, moisture, or climate changes.

SPST only—normally open or closed.

Compensated for ambient temperature changes from —55° to +70° C. Heaters consume approximately 2 W. and may be operated continuously. The units are **rugged, explosion-proof, long-lived, and—inexpensive!**

TYPES: Standard Radio Octal, and 9-Pin Miniature . . **List Price, $4.00.** Standard Delays

Also—**Amperite Differential Relays:** Used for automatic overload, under-voltage or under-current protection.

PROBLEM? Send for Bulletin No. TR-81

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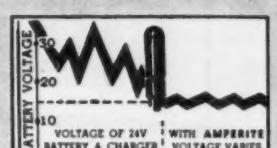
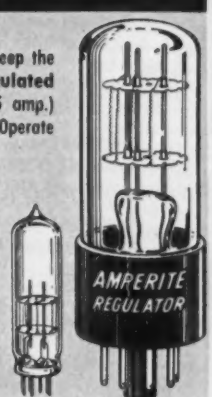
Amperite Regulators are designed to keep the current in a circuit **automatically regulated** at a definite value (for example, 0.5 amp.) . . . For currents of 60 ma. to 5 amps. Operate on A.C., D.C., or Pulsating Current.





Hermetically sealed, they are not affected by changes in altitude, ambient temperature (—55° to +90° C.), or humidity . . . Rugged, light, compact, most inexpensive . . . . . **List Price, $3.00.**

Write for 4-page Technical Bulletin No. AB-51

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In Canada: Atlas Radio Corp., Ltd., 50 Wingold Ave., Toronto 10

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RAYTHEON MISSILE SYSTEMS DIVISION

changed. With associated d-c servo power amplifier, natural frequency exceeds 150 cps. Auxiliary recorder console is available for automatically recording frequency response on an X-Y recorder. It shows natural frequency and damping ratio at a glance.

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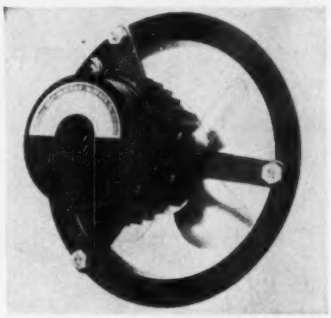

Motors for fans, blowers

AIR-MARINE MOTORS, INC., 369 Bayview Ave., Amityville, L. I., N. Y. Available in 320 to 1,000 cycles, 200 v, these 3-phase, variable frequency motors eliminate the need for running capacitors. The 4-in. axial fan illustrated, a typical unit, delivers 240 cfm at 0 in. s-p, 400 cycles. Ambient range is −55 C to +125 C. Units have a typical application in airborne radar cooling and meet MIL-E-5400 and MIL-E-5272A.

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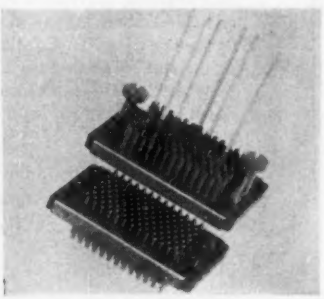

Power Connector 130-contact

DEJUR-AMSCO CORP., 45-01 Northern Blvd., Long Island City 1, N. Y. Series 250 rectangular power connector is suitable for heavy duty applications in aircraft and electronic equipment requiring high dielectric and mechanical strength.

RMS voltage breakdown at sea level is 1800; current rating 10 amperes continuous, 13 amperes maximum; contact area of either plug or receptacle, slightly less than 5 sq in. Polarizing screwlocks provide a positive means of locking plug and receptacle against vibration or accidental disconnection.

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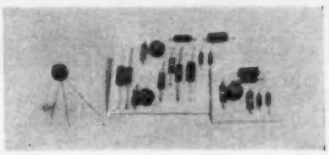

Silicon Component "circuit equivalent"

SOLID STATE PRODUCTS, INC., One Pingree St., Salem, Mass. The silicon Trigistor has characteristics comparable to the circuit function of a flip-flop or bistable multivibrator. The *pnpn* device has the unique property of triggered turn off as well as triggered turn on control at its base. Far fewer components are required with Trigistor circuitry as compared with transistors or other switching elements. Trigistor circuit is illustrated on printed board at right.

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Electronic Generators two models

THE INDUSTRIAL TEST EQUIPMENT CO., 55 E. 11th St., New York 3, N. Y. Models 150 and 250 Powertron electronic generators provide output powers of 160 va and 250 va respectively. They provide a fixed output frequency of 400 cps ±0.25 percent and a variable output frequency with a range of 350-450 cps. An input jack is also provided for output frequencies from 50-4,000 cps. Some features include: continuously variable output voltage from 0-120 v, less than 1 percent output distortion, better than 1 per-

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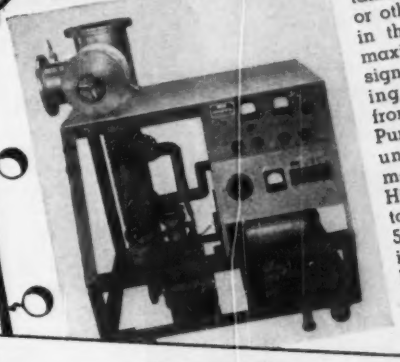
Kinney®

PW-600 HIGH VACUUM PUMPING SYSTEMS



Speedy evacuation of chambers, tanks, bell jars, tubes, furnaces or other equipment to pressures in the low micron region plus maximum utility and flexibility signalize these KINNEY Pumping Systems. Readily moved from one station to another, PW Pumping Systems, because of a unique Rotatable T-Manifold, may be quickly converted to High Vacuum Evaporators. Factory tested to attain pressures to 5×10^{-6} mm Hg. without coolant in the cold trap . . . pressures below 5×10^{-7} mm Hg. with coolant in the trap.

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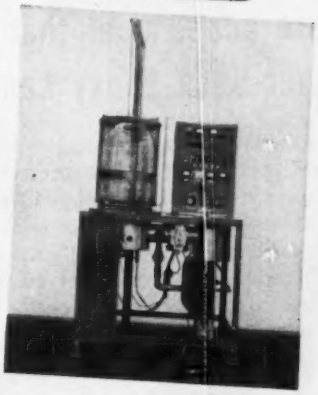

A superior unit for performing highly specialized work in optical filming and research investigations. The conventional flat base plate is replaced by a cylindrical stainless steel chamber—permitting introduction of many more and varied feed-throughs, such as: precise optical measuring equipment. This is an advanced design evaporator with extra pumping capacity and liquid nitrogen cold trap, attaining ultimate pressures of 5×10^{-6} mm Hg. It is capable of producing multi-layer films under monitored control of reflection and transmission.

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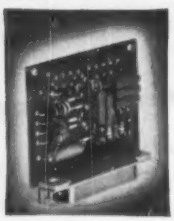
A topper in any language

It's better than the best XXXP grade, it's lighter and more economical than G-10, it's Taylor XY-1 Paper-Base Epoxy Laminate

When you want extremely high reliability in printed circuits, with the additional advantages of flame retardance, chemical resistance, good solderability and high bond strength—specify Taylor XY-1 copper-clad laminate. It is self-extinguishing in 1 second, has excellent resistance to alkalis, acids and solvents, has a solder time resistance at 500°F. of 30 seconds in 1-oz. copper and 50 seconds in 2-oz., and a bond strength of 10 lb. in 1-oz. copper and 13 lb. in 2-oz. Sheets available with copper on one or both sides.



Unclad Taylor XY-1 has many advantages, too. It can be substituted for glass-base epoxy laminates to reduce cost and weight. It has excellent electrical, mechanical and machining properties. Contact us for complete technical data and expert guidance in applying this new material. TAYLOR FIBRE CO., Norristown 40, Pa.

Taylor

LAMINATED PLASTICS VULCANIZED FIBRE

174 CIRCLE NO. 174 READER SERVICE CARD

cent regulation from no load to full load, and the ability to be used with loads of any power factors.

CIRCLE NO. 291 READER SERVICE CARD

A-C/D-C Converter phase-sensitive

NORTH ATLANTIC INDUSTRIES, INC., 603 Main St., Westbury, N. Y. Model 401 is a precision phase-sensitive a-c to d-c converter. Designed to permit the use of readily available d-c instruments for measurement of a-c signals, the converter provides either single or double-ended output proportional to the rms of the fundamental, or to the in-phase or quadrature component of the a-c signal. A built-in phasing control permits the reference to be advanced or retarded over a range of approximately ±20 deg; thus measurements can be made in phase with a selected reference angle. Output is unaffected by harmonics in the signal and its linearity is within 0.05 percent.

CIRCLE NO. 292 READER SERVICE CARD

Modulators versatile units

LEVINTHAL ELECTRONIC PRODUCTS, INC., Stanford Industrial Park, Palo Alto, Calif. Models 75M-1, 75M-2, and 75M-3 modulators offer peak pulse powers respectively of 0.6, 1.2, and 2 megawatts. Each includes a h-v d-c power supply with less than 0.5 percent ripple and a filament supply with 40 kv low-capacitance isolation. Units are useful in tube-development work or for incoming tube inspection by equipment manufacturers. They are

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BEKEY Custom 120-pole hyspersyn® motor drives new Genisco precision centrifuge

To attain desired accuracies, angular velocity of the Genisco A931 Centrifuge must be constant to 1 part in 50,000. To get this constancy, Genisco uses a Bekey 120-pole, three phase, *hys*teresis motor with induction start and *per*manent magnet excitation for *syn*chronous operation.

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G-E WET-SLUG TANTALYTIC* CAPACITORS

for miniaturized high capacitance, low-voltage transistor applications

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GENERAL ELECTRIC

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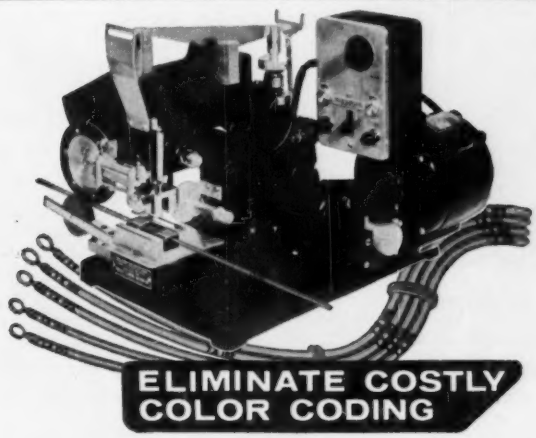

and Reduce Wire Inventories with a

KINGSLEY Wire-Marking Machine

Now you can permanently mark each wire or piece of plastic tubing with its own individual circuit number, at any desired spacing... at a speed of 11,000 stampings per hour!

You need only one color of wire for as many codes as necessary. Simplify your assembly methods and speed production with the same machine that has proven so successful in the aircraft industry.

Write for complete information

KINGSLEY MACHINE CO., Hollywood 38, Calif.

SEE US AT WESCON BOOTH 1007

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Grayhill Push Button Switches

From normal, conventional size to ultra-miniature — the Grayhill line of push button switches can meet virtually every requirement. Rated capacities range from 10 amp. to 1/10 amp. 115 V. AC resistive — and single or double pole, single throw, — silent or snap action styles and a solderless terminal style are available.

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Grayhill INC.

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"PIONEERS IN MINIATURIZATION"

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549-8

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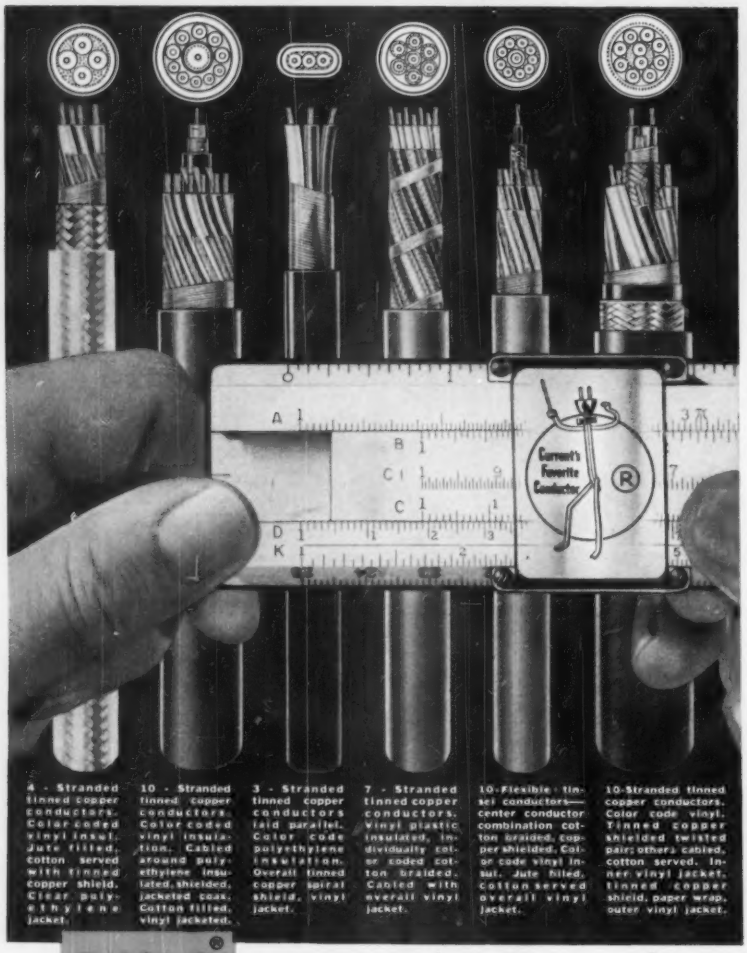
CUSTOM SPECS...


Current's Favorite Conductor
4 - Stranded tinned copper conductors. Color coded vinyl insul. Jute filled, cotton served with tinned copper shield. Clear polyethylene jacket.
10 - Stranded tinned copper conductors. Color coded vinyl insulation. Cabled around polyethylene insulated, shielded, jacketed coax. Cotton filled, vinyl jacketed.
3 - Stranded tinned copper conductors laid parallel. Color code polyethylene insulation. Overall tinned copper spiral shield, vinyl jacket.
7 - Stranded tinned copper conductors. Vinyl plastic insulated, individually color coded cotton braided. Cabled with overall vinyl jacket.
10-Flexible tinsel conductors—center conductor combination cotton braided, copper shielded. Color code vinyl insul. Jute filled, cotton served overall vinyl jacket.
10-Stranded tinned copper conductors. Color code vinyl. Tinned copper shielded twisted pair; others cabled, cotton served. Inner vinyl jacket, tinned copper shield, paper wrap, outer vinyl jacket.

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adaptable for use with magnetrons as high-power pulsed signal sources, with twt's as broadband high-power pulsed microwave amplifiers, or with klystrons as narrowband amplifiers.

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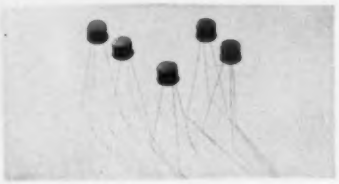

Silicon Transistor switching type

FAIRCHILD SEMICONDUCTOR CORP., 545 Whisman Rd., Mountain View, Calif. The 2N706 is an extremely fast silicon switching transistor optimized for saturated logic circuits operating at low current levels. Device can be operated in a saturated condition with virtually no sacrifice in speed. Double diffused mesa construction gives typical direct coupled transistor logic propagation delay of 5 milliμsec per inverter. Circuit design with the 2N706 is simplified because there is no need to use additional circuit components to keep it out of saturation.

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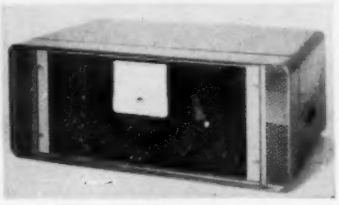

Impedance Tester & phase extrapolator

WESTERN ELECTRONIC PRODUCTS Co., 655 Colman St., Altadena, Calif. An impedance tester and phase extrapolator for testing capacitors and iron-core devices such as transformers and reactors measures a wide variety of parameters. Accuracy is better than 1 percent over a 30 to 20,000 cps frequency range. Impedance range is from 1 ohm to 99,999 ohms. Unit can make accurate measurements at actual operating voltage and frequency of component under test as required

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SOMETHING NEW IN SLOTTED SECTIONS

Actually, this is a new kind of Standing Wave Detector, which completely makes obsolete the 8-foot monsters, for impedance and VSWR measurements from 100 to 1000 mc/s.

The PRD Type 219 is only 8 inches long and weighs a "pocketable" four and one-half pounds.

As if these facts were not startling enough, the 219 also features:

- Direct reading of VSWR
- Direct reading of angle of reflection coefficient
- Direct reading of reactive component sign
- Matched load for self-calibration supplied
- Adaptability to most coaxial lines, including the LT and new TNC series
- Low cost
- Rugged construction

Listed below are a few of the important specifications.

Frequency Range:	100 to 1000 mc/s
Residual VSWR:	Less than 1.03
Minimum Input Signal:	Approx. 1V at 100 mc/s; 0.1V at 1000 mc/s for measuring a matched load
Characteristic Impedance:	50 ohms
Detector:	Crystal included
RF Input Connector:	BNC jack
RF Output Connector:	Type N jack supplied. Connector types available include types C, BNC, LT, TNC, ⅞" coax.
Audio Output Connector:	BNC jack
Dimensions:	8" L x 5" W x 5¾" H
Weight:	4½ pounds

f.o.b. Brooklyn, New York

Note to owners of the new PRD Catalog, E-8: Don't bother reading this ad. All these details and more can be found on page B-13. If you are unfortunate enough not to own a copy of this designers' workbook, send your request on your company letterhead please.

If all you want are specifications on the 219, fill out the inquiry card in this magazine.

POLYTECHNIC RESEARCH & DEVELOPMENT CO., INC.

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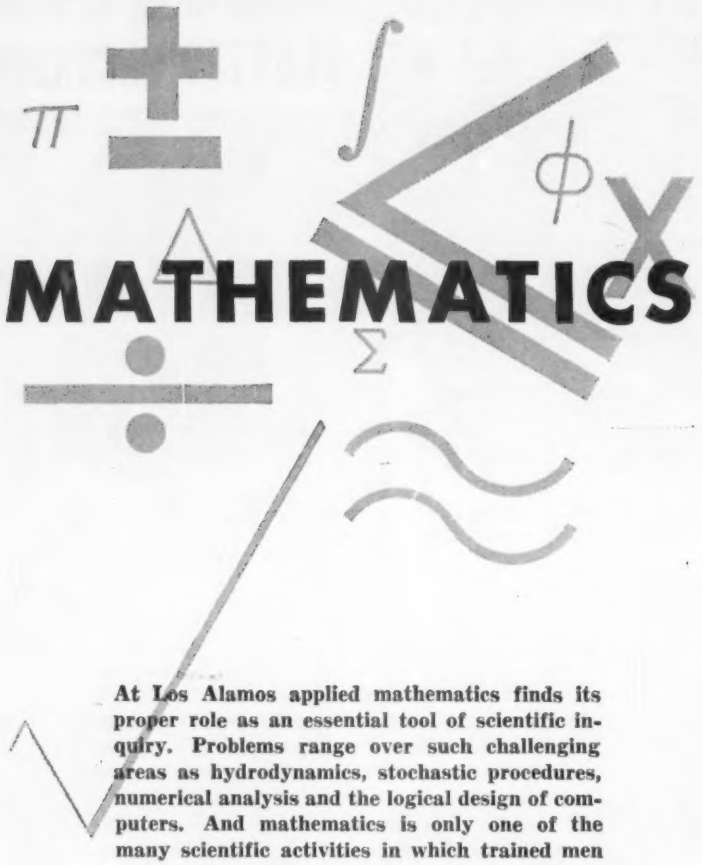

At Los Alamos applied mathematics finds its proper role as an essential tool of scientific inquiry. Problems range over such challenging areas as hydrodynamics, stochastic procedures, numerical analysis and the logical design of computers. And mathematics is only one of the many scientific activities in which trained men and women with imagination find stimulating opportunities in the Laboratory of the future.

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by MIL-T-27 specifications, rather than at a fixed arbitrary frequency and voltage.

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Laminated Plastics flame-retardant

SYNTHANE CORP., Oaks, Pa., announces three flame-retardant laminates. Grades FR-2 and FR-1 are paper-base laminates with phenolic resin binders. Grade EP-22 is an Alpha-paper-base plastic with epoxy resin which sells at a lower price than glass-base epoxies. Grades FR-2 and EP-22 are recommended especially for p-c applications. Grade FR-1 has wide use potential in electrical applications such as switchgear components where flame-retardance is an important factor. Both FR-2 and EP-22 can be furnished either plain or copper-clad on one or both sides.

CIRCLE NO. 296 READER SERVICE CARD

Phase Standard or shifter

ACTON LABORATORIES, INC., 533 Main St., Acton, Mass. Type 714A is a tenth degree secondary phase standard. Features are: a single audio frequency (400 cps standard) to produce known phase angles at output terminals; it may be used as either a phase shifter or phase standard, one control—the phase angle selector with choice of 0, 30, 60, 90, 120, 150 and 180 deg or others on special order; phase angle stability over a variety of operating conditions; it does not require an extremely precise input frequency; no external calibrating or zeroing controls are required.

CIRCLE NO. 297 READER SERVICE CARD

Lighted Switches solenoid-held

ELECTROSNAP CORP., 4220 W. Lake St., Chicago 24, Ill. Solenoid-held lighted push-button panel switch

requiring 1 sq in. of panel space is designed for electrical interlock systems, remote control monitoring of equipment controlled by the switch and other applications. Colored plastic button can be heat-stamped with legend. It has two 6 v or 28 v lamps, 5 amp switch and integral solenoid. Solenoids are also available on 1-lamp models. Firm also has available in-line digital readout which can project any character or image produced on film. The Digilite measures 1 by 1½ by 5 in. and can be relamped from front. New environment-free limit switches in 1, 2 and 3-pole models are also announced.

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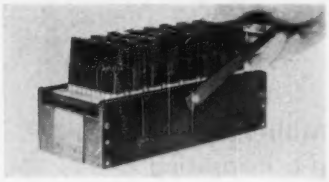
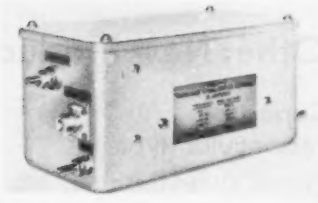


Program Selector switch type

AMP INC., Harrisburg, Pa. Double throw program selector switch permitting selection of 2 distinct circuit combinations was designed for such applications as missile instrumentation. It has up to 1,500 poles. Ratings are 5 amp max current, continuous duty; 1,500 vdc between adjacent contacts at sea level. Switch is fully sealed and wiping action pre-cleans contacts. Wiring to switch rear is accomplished with taper pins. A variation is a combination plug board and dt switch with all throw positions independently patched.

CIRCLE NO. 299 READER SERVICE CARD



LIS Networks two models

STODDARD AIRCRAFT RADIO CO., INC., 6644 Santa Monica Blvd., Hollywood, Calif. Models 91221-1 (50

NOW!

Certified PRECISION STOCK GEARS

STOCK GEARS 32 TO 120 PITCH
A.G.M.A. PRECISION #3...
IMMEDIATE DELIVERY

Tens of thousands of gears of all types . . . 32, 48, 64, 72, 96 and 120 diametral pitches of 14½° and 20° pressure angles. APPCO offers them all for quick delivery. Each one "Certified" to meet or surpass A.G.M.A. specifications.

APPCO Certified Precision Stock Gears offer 7 finishing options on aluminum gears at no extra cost . . . compatible bore tolerances for accurate fitting of gears, shafts and bearings. Each gear is completely sealed on shipping tray with plastic cover . . . always "factory fresh" and free of dust, corrosion and scratches.

APPCO Precision Gears are engineered and manufactured to allow for accurate assembly of precision units . . . held to tolerances that assure precise fits to standard instrument bearings, shafting, etc., according to accepted industry practice and A.G.M.A. specifications. For complete technical data and catalog write to Atlas Precision Products Co., Castor and Kensington Aves, Phila. 24, Pa.

Division of
PRUDENTIAL INDUSTRIES INC.

before the bird takes off

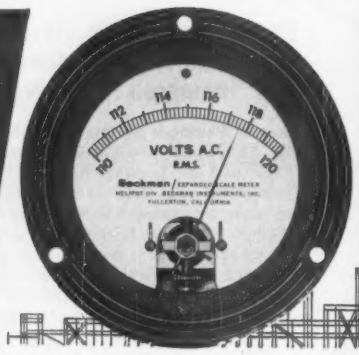
During preflight checkout, ground power supplies must be meticulously monitored to avoid limping undervoltage, crippling overvoltage.

How?

BECKMAN Expanded Scale Voltmeters—with accuracy to a fraction... readability to hundredths! That's vital volt-splitting at the moment of "Go—No Go," when operation depends upon precise power input with no room for guesswork. (And no trifling with "average" readings: BECKMAN AC meters give honest, direct rms readings on all wave forms.)

vital

VOLT



splitting

Helipot offers you hundreds of models ...either AC or DC...in divers shapes, sizes and voltage ranges. (Not to mention voltage monitoring packages, which may include our expanded scale frequency meters and linear scale ammeters, too.) All have uncommon accuracy in common, plus resolution ten times that of conventional meters!

Incredible?

Make us prove it by asking for Data File A324.

Beckman® / Helipot®

Helipot Division of
Beckman Instruments, Inc.
Fullerton, California
Engineering representatives
in 29 cities

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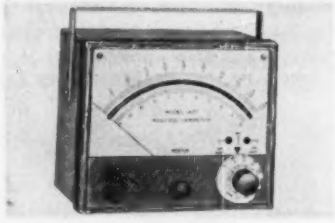
potentiometers • dials • delay lines • expanded scale meters • servomotors • breadboard parts

ampere) and 91222-1 (100 ampere) are line impedance stabilization networks. Either, when inserted in an a-c/d-c power line, presents a definite r-f impedance to the interference-producing equipment and to the power source. Thus isolated, accurate and repeatable interference acceptance tests may be performed upon the equipment in conjunction with radio-interference measuring equipment.

CIRCLE NO. 300 READER SERVICE CARD



Milli-Volt/Ammeter
d-c measuring

WESTON INSTRUMENTS DIV., Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N. J. Model 1477, an electronic milli-volt/ammeter measures d-c currents of 10-1,000 μa and d-c voltages of 1-1,000 mv. Power drain from source is essentially zero but gain supplies 1 ma to drive meter and external load up to 5 kilohms. Essentially zero drift, its long time drift is less than 2 μv. A servo amplifier stabilizes the meter. Accuracy is 2 percent in lowest range and 1 percent in others; resolution 2 μv or 0.02 μa; gain stability and output linearity, within 0.1 percent above 1 mv or 200 μa. Precision resistor calibration avoids tube replacement selection.

CIRCLE NO. 103 READER SERVICE CARD

Other New Products

Capacitor
rectangular type

PLASTIC CAPACITORS, INC., 2620 N. Clybourn Ave., Chicago 14, Ill. Type LK rectangular capacitor features smaller size and four times the life of MIL-C-25A. Other advantages include superior resistance; better power factor; withstands greater overloads; may

Clark Fishel takes the stand for electronics

Texas Instruments Incorporated is a name that has skyrocketed into prominence since its adoption in 1951 by a company then principally engaged in geophysical instrumentation and exploration for petroleum. In the succeeding eight short years, TI has extended its activity into electrical, electronic and nuclear fields with such vigor that sales have increased twelve-fold to a current rate of over $185,000,000.

Clark W. Fishel is Merchandising Manager of TI, which now is composed of four manufacturing divisions: the Semiconductor-Components Division makes transistors, diodes, rectifiers, resistors, capacitors, IR cells, solar cells, etc.; the Apparatus Division makes radar, sonar, infrared, and magnetic equipment and systems; the GeoSciences and Instrumentation Division is still the world's largest geophysical exploration contractor and makes geophysical and industrial instruments and systems; the Metals & Controls Division makes clad metal products, thermostatic and electrical controls, and nuclear fuel elements and cores.

Mr. Fishel, according to a November 11, 1958 count, 80 members of your organization paid to receive electronics each week. Yet your company ordered 32 company-addressed subscriptions. Would you explain this?

Considering the importance of the electronics industry to us, and the importance of communication to any industry or corporation in a fast-moving technology . . . I would be surprised if it were any different.

Mr. Fishel, TI is currently concentrating 86 pages of advertising in electronics. In 1958 you ran 25 pages of bleed-color advertisements, 15 pages of B&W bleed and 13 covers. Would you tell why electronics plays such a dominant role in your advertising plans?

Because—due to its editorial format and circulation—it covers the industry like a blanket. Certainly I know that we can buy magazines with a cheaper rate per gross thousand or with more readers in some specific category . . . but nowhere else can we find such a catholic combination. Naturally we advertise heavily in it.

If it's about electronics, it's advertised and read in **electronics.**

electronics

Published WEEKLY plus the mid-year electronics BUYERS' GUIDE

A McGraw-Hill Publication • 330 West 42nd Street, New York 36, N. Y.

ADAPTABLE FOR ALL APPLICATIONS

Hoyt Panel Meters

NEW! Matching AC and DC Meters in striking configuration of gleaming transparent polystyrene modernize all panels. Interchangeable with 3½" diameter meters, ruggedly built, 2% accuracy, full-width scales in all popular ranges. HOYT No. 1035 DC and No. 1036 AC.

Be sure of the highest accuracy, dependability, and readability — *plus economy* — with HOYT precision electrical instruments. Moving coil, rectifier, and repulsion types available in a wide variety of sizes, ranges, cases, and colors—many with parallax-free, mirror scales . . . the *complete* line of matched AC and DC Panel Meters for original equipment or replacement use. Also, custom-designed to your most exacting specifications.

Write for fully illustrated literature containing descriptions, engineering data, and low prices.

Write to Export Manager regarding world-wide availability for Electronic, Industrial, and Automotive applications.

See the HOYT Line at the WESCON Show

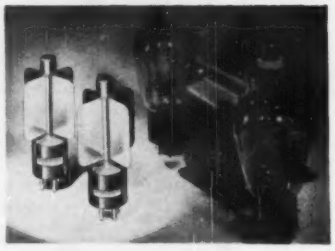
Hoyt SINCE 1904

ELECTRICAL INSTRUMENTS

BURTON-ROGERS COMPANY
Sales Division
42 Carleton St., Cambridge 42, Mass., U.S.A.

be operated to 125 C; voltage ratings from 600 to 50,000 volts.

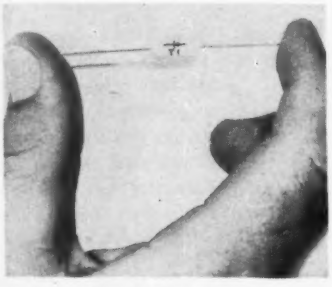
CIRCLE NO. 104 READER SERVICE CARD



Silicon Cartridges high voltage

INTERNATIONAL RECTIFIER CORP., 1521 E. Grand Ave., El Segundo, Calif. Designed to replace type 866 mercury vapor rectifier tubes (as well as the filament transformer necessary to tube operation), these h-v silicon cartridges provide ⅔ reduction in space and weigh less than ⅛ of equivalent tube circuitry. Rated at 6,400 piv, these units will provide d-c output currents of 250 ma at 75 C ambient temperature. The entire housing and cooling fins of the multiple junction, hermetically sealed cartridges acts as a heat exchanger to dissipate the inherently low internal power losses of silicon.

CIRCLE NO. 105 READER SERVICE CARD



In-Line Rectifiers ceramic-cased

TEXAS INSTRUMENTS INC., P. O. Box 312, Dallas, Texas, announces a line of in-line ceramic-cased rectifiers. The dense-alumina ceramic case provides 1.5-ampere average rectified forward current at 50 C through efficient heat dissipation. The diffused-silicon rectifiers double their efficiency when placed on a

one word more about the

Amperex® 6CA7/EL34
OUTPUT PENTODE

NOW ITS RATED POWER OUTPUT IS 60 WATTS (Class AB_1)

We are pleased to announce that as a result of the further exploration of the 6CA7's capabilities . . . its power output rating has been raised to 60 watts in a distributed load circuit. This was achieved by increasing the screen grid voltage to 500V. The screen voltage rating now equals the plate voltage rating, thus greatly simplifying the design of power supplies.

Class AB_1 Audio Amplifier
Distributed Load Connection
Typical Operation
(Fixed Bias—Two Tubes Push Pull)

Plate Supply Voltage	500 V
Grid No. 2 Supply Voltage (See Note)	500 V
Grid No. 1 Bias (approx.)	−44.5 V
Plate to Plate Load Resistance	7000 Ω
Plate and Grid No. 2 Current (Zero Signal)	2x57 mA
Plate and Grid No. 2 Current (Max. Signal)	2x112 mA
Input Signal Voltage (rms)	32 V
Power Output	60 W
Harmonic Distortion	2.5%

NOTE: Screen voltage is obtained from taps located at 43% of the plate winding turns. An unbypassed resistor of 1KΩ in series with each screen grid is necessary to prevent screen overload.

ask **Amperex** *about detailed data and applications engineering assistance on hi-fi tubes for hi-fi circuits.*

AMPEREX ELECTRONIC CORP.
230 Duffy Avenue, Hicksville, L. I., N. Y.

CIRCLE NO. 147 READER SERVICE CARD

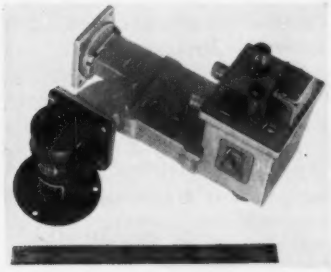
2 in. by 2 in. heat sink, rectifying up to 3 amperes at 50 C. Voltage ratings are 200 to 600 v piv and operating temperature range is from −65 to +150 C with current rating of 500 ma at 150 C.

CIRCLE NO. 106 READER SERVICE CARD

Display Unit
Sonalyzer adapter

KAY ELECTRIC CO., Maple Ave., Pine Brook, N. J. Sonagram display adapts output of Sonalyzer model 30 for three-dimensional display on any conventional cro with a long persistence screen. Sonalyzer is a 30-channel all-electronic spectrum analyzer which displays complex waveforms from 100 cps up to 20 kc. Sonagram supplies horizontal and vertical deflection voltages to swing a 5-in. tube on scopes where there are no d-c amplifiers or where linearity of existing amplifiers is doubtful.

CIRCLE NO. 107 READER SERVICE CARD



Mixer-Preamplifier
for X-band

LEL, INC., 380 Oak St., Copiague, N. Y. One of a new series of matched mixer-preamplifier units, model MMX integrates microwave and i-f preamplifier, is tested at X-band for gain and selectivity and adjusted for minimum noise figure. Standard units have output frequencies of 30 or 60 mc.

CIRCLE NO. 108 READER SERVICE CARD

Now! McCoy

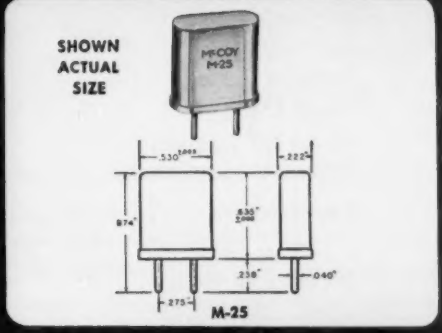
MINIATURIZED Crystals
in all frequencies above 1 Mc.

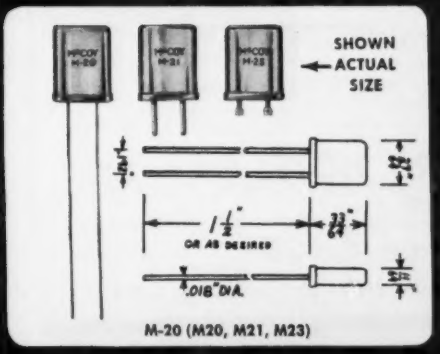
Possessing all of the fine characteristics of the regular size crystals that for years, have made the McCoy name a synonym for quality — these small counterparts can be relied upon to deliver the utmost in frequency control despite wide temperature variations and extreme conditions of shock and vibrations.

FREQUENCY RANGE: 1.0 Mc. to 200 Mc.

The latest addition to the McCoy line. It fills the growing need for miniature crystals, particularly in the 1.0 to 7.0 Mc. range, that have the same frequency stability, performance, and shock resistance previously only available in larger sizes.

SHOWN ACTUAL SIZE





FREQUENCY RANGE: 3 Mc. to 200 Mc.

Adaptable to multi-channel design for communications and frequency control equipment. Can be plugged into sub-miniature tube sockets, wired into miniature selector switch assemblies or can be soldered to printed circuit terminal boards.

MEETS SPECS.: MIL-C-3098B, CAA R-916 and ARINC No. 401

Write today for our free illustrated catalog. For your specific needs, write, wire or phone us. Our research section will be glad to assist you.

McCoy

ELECTRONICS CO.
MT. HOLLY SPRINGS, PA.
Phone: HUnter 6-3411
DEPT. E-8
See us at Wescon Booth 212.

Greetings...WESCON MEMBERS!

AVCO offers its sincere wish that your visit will be both enjoyable and informative.

Career Opportunities for:

SCIENTISTS & ENGINEERS

AVCO . . . pioneer in re-entry . . . is exploring new approaches to space and missile technology.

Supervisory, Senior and Junior positions are available for creative Scientists and Engineers in the following fields:

- Microwave Telemetry Systems
- Missile Antenna Systems
- Plasma Propagation
- Electromechanical Systems and Components
- Modulation and Switching Systems
- Circuit Analysis
- HF and VHF Transmitter Systems and Components
- HF and VHF Receiver Systems
- Single Side Band Systems
- Frequency Synthesizer Systems
- Electronic Systems Synthesis
- Ground Engineering Design
- Range Instrumentation Systems
- Flight Test Engineering
- Environmental Test
- Quality Assurance Engineering

The division's new suburban location provides an unusually attractive working environment outside of metropolitan Boston, close to educational institutions and cultural events.

San Francisco INTERVIEWS

. . . during the Convention with members of our Technical Staff may be arranged by calling the

GAYLORD HOTEL Penthouse Suite, 620 Jones Street

GRaystone 4-4256

TUES. through FRI. — Aug. 18 - 21 from 9 A.M. to 9 P.M.

If an interview is inconvenient write to: Mr. Richard Rubino — Dept. W-8 Scientific and Technical Relations

See our display of Environmental Test Equipment in Booth L-14 at the Cow Palace

AVCO Research & Advanced Development

201 Lowell St., Wilmington, Mass.

Literature of

MATERIALS

Microwave Insulators. Tri-Point Plastics, Inc., 175 I. U. Willets Road, Albertson, L. I., N. Y. Bulletin 2895 covers microwave insulators of Teflon styrenes, Kel-F and other high dielectrics machined to tolerances of 0.001 in. and less.

CIRCLE NO. 109 READER SERVICE CARD

Teflon-Insulated Terminals. Taurus Corp., 8 Coryell St., Lambertville, N. J., has available a catalog describing standoff and feed-through terminals insulated with Teflon.

CIRCLE NO. 110 READER SERVICE CARD

Magnetic Shields. Magnetic Shield Division, Perfection Mica Co., 1322 No. Elston Ave., Chicago 22, Ill. Data sheet 146 covers Co-Netic Netic magnetic shields which enclose the field around shaded pole motors, eliminating detrimental magnetic interaction in the completed electronic package.

CIRCLE NO. 111 READER SERVICE CARD

COMPONENTS

Control Transformers. Daystrom Transicoil Division, Daystrom, Inc., Worcester, Montgomery Co., Pa. A new size 8 synchro control transformer line for air and missile borne electronics is described in data sheet 801-CT4.

CIRCLE NO. 112 READER SERVICE CARD

Potentiometers. Maurey Instrument Corp., 7924 S. Exchange Ave., Chicago 17, Ill., offers a complete catalog of single-turn, wire-wound precision pots from ½ in. to 3 in. diameter.

CIRCLE NO. 113 READER SERVICE CARD

Coil Forms. Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass. A 22 in. by 34 in. reference chart shows all pertinent data on Cambion ceramic and phenolic coil forms.

CIRCLE NO. 114 READER SERVICE CARD

the Week

Toroidal Inductors. PCA Electronics, Inc., 16799 Schoenborn St., Sepulveda, Calif. Bulletin TL-102 devotes 4 pages to a line of toroidal inductors. Graphs and charts are included.

CIRCLE NO. 115 READER SERVICE CARD

C-R Tubes. Electronic Tube Corp., 1200 E. Mermaid Lane, Philadelphia 18, Pa. Handy chart compiles physical and electrical characteristics of over 60 crt's for industry and military.

CIRCLE NO. 116 READER SERVICE CARD

EQUIPMENT

Recorder Reproducer. Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif., offers an illustrated 4-page bulletin describing the type 5-781 magnetic tape continuous-loop recorder/reproducer.

CIRCLE NO. 117 READER SERVICE CARD

Dielectric Test Set. James G. Biddle Co., 1316 Arch St., Philadelphia 7, Pa. Bulletin 22-5 describes the portable and bench models of the 5 kv-lma dielectric test set.

CIRCLE NO. 118 READER SERVICE CARD

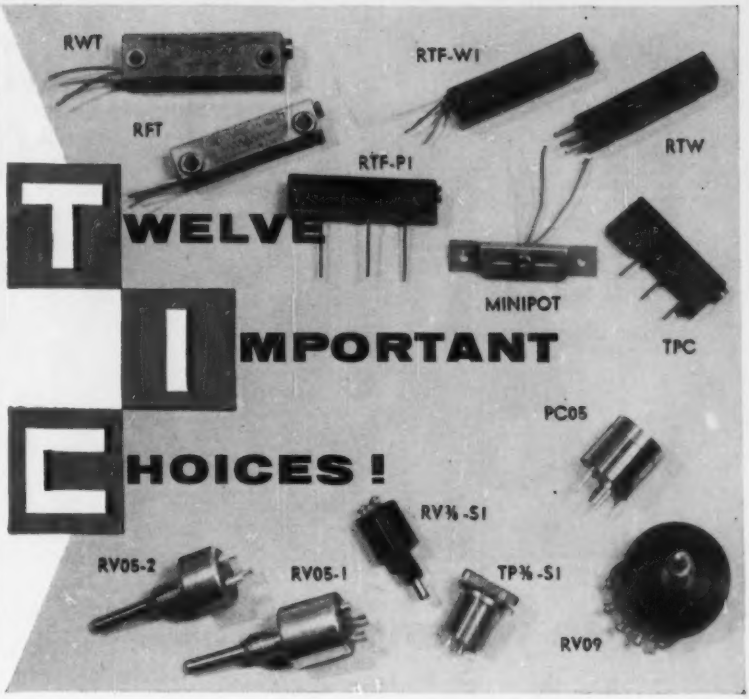
Mobile Communications. Kaar Engineering Corp., 2995 Middlefield Road, Palo Alto, Calif. An interpretation of the FCC rules and regulations affecting mobile communications effective Sept. 11, 1958 is available in a brochure.

CIRCLE NO. 119 READER SERVICE CARD

FACILITIES

Coax Cable Connectors. Dage Electric Co., Inc., 67 N. Second St., Beech Grove, Ind. Catalog 401 illustrates the company's facilities and lists all the military types and many special types of coax cable connectors manufactured by Dage. Several aids to the buyer and engineer are included.

CIRCLE NO. 120 READER SERVICE CARD



TWELVE IMPORTANT CHOICES!

PRECISION TRIMMER POTENTIOMETERS by TIC are standard in twelve different styles and each in a wide range of resistance values. The extensive use of trimmers in such applications as airborne, shipborne and ground based military electronic equipment for navigation, flight control, fuel control, radio transmission and reception, telemetering, computers, fire control and many others demands reliability and stable operation under severe environmental conditions. TIC quality-control procedures and environmental testing assure the user of the ultimate in dependable trimmer potentiometers.

TWELVE IMPORTANT CHOICES — six box type and six rotary type multiturn and single turn with wirewound or metallic film resistance elements, high temperature-resistant construction, varied mounting methods, and sizes ranging from micro-miniature to the size of a quarter in diameter, permit the design engineer optimum freedom to select the unit best suited to his application. Special designs may be readily accommodated by TIC engineers.

For new catalog of the trimmers illustrated above write, wire or call

TIC

Subsidiaries:
Technology Instrument Corp. of Calif. North Hollywood, Calif.
Acton Laboratories, Inc., Acton, Mass.
Tucson Instrument Corp., Tucson, Ariz.
Servotrol, Inc., Chicago, Ill.
Altomac Corp., Canton, Mass.

TECHNOLOGY INSTRUMENT CORPORATION

569 MAIN STREET
ACTON, MASS.

CIRCLE NO. 185 READER SERVICE CARD

Oliver: wit and energy

CHAIRMAN of the executive committee for this month's Western Electronics Show and Convention is Bernard M. Oliver, energetic, witty vice president in charge of research and development at Hewlett-Packard in Palo Alto, Calif.

No newcomer to industry affairs, he officiated as Wescon chairman in 1957, and has been a member of the convention board for three years. He also serves on the board of directors of the national Institute of Radio Engineers, was elected a Fellow in 1954, and is a past chairman of the San Francisco IRE Section.

Geographically, Barney hasn't moved very far in his 43 years. His 70-acre ranch is situated in the mountains behind his boyhood home in Santa Cruz. Scholastically and professionally, it's a different story. In quick succession he picked up a B.A. in electrical engineering from Stanford and an M.S. from CalTech. When only 23 he received, magna cum laude, his Ph.D. in E.E. from CalTech. "It's obvious," points out a colleague, "that he wasted about as little time back in those days as he does today."

Before joining H-P in 1952, Oliver spent 12 years at Bell Labs—working on automatic tracking radar, information theory research and high-efficiency systems. He holds 40 U. S. patents in electronics, and several others are pending.

A prolific writer, he has authored numerous technical articles for various professional journals.

To keep in a scholarly frame of mind, he has lectured in electrical engineering at Stanford since 1953.

A devoted father of three, Barney last year chairmanned a drive which secured an 80-acre camp site for the Palo Alto Girl Scouts (in which daughters Karen and Gretchen are active).

He modestly points out that his son Eric (through phonics) is reading at the age of four.

As a graduate exchange student in Europe before World War II, Barney became fascinated with vineyards and wine-making. Today he runs an experimental one-acre vineyard and an associated winery as a hobby at his mountain ranch.

Cultural interests run to music (classical through folk) and the theater. His wife Priscilla, formerly a professional actress, accompanies him on business trips to the east coast, and the two of them seldom miss a New York play.

Launch New Company in West

FORMATION of Microwave Electronics Corp., for R&D and manufacture of microwave electronic devices, was recently announced by Stanley F. Kaisel, president.

Executive offices, laboratory and manufacturing plant are located in Palo Alto, Calif. The facilities provide 10,000 sq ft of working space.

Kaisel said the initial emphasis will be devoted to work on t-w amplifiers and b-w oscillators. The firm plans to develop a proprietary line of tubes covering a broad frequency range.

Canova Joins Datex Corp.

NEW senior project engineer in the systems group of Datex Corp., Monrovia, Calif., is George Canova. He was an electronic engineer with Burroughs ElectroData Division in Pasadena since 1954, and prior to that was with Lockheed Aircraft.

A subsidiary of Giannini Controls Corp., Datex designs and manufactures shaft encoding devices, pressure scanners, and data-processing systems.

Eldema Appoints Research Head

ELDEMA CORPORATION, El Monte, Calif., manufacturer of miniature indicator lights and switches, announces the appointment of Dwayne A. MacDonald as chief engineer and director of research.

MacDonald was formerly with Convair as a project engineer in analog computer design and development.

Wescon Exhibits Up 27 Percent

SAN FRANCISCO—Display space of 300,000 sq ft in Cow Palace here will be occupied by 960 booths for this year's Wescon show, Aug.

See it at WESCON

In-Circuit Transistor Tester

Measure transistor Beta—without removing transistor from circuit—with equipment power off!

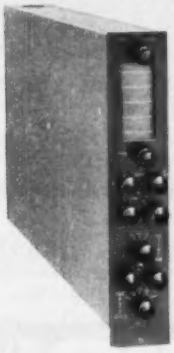
Ideal for production line testing, incoming inspection of transistorized sub-assemblies, field trouble-shooting and maintenance.

Incorporating an internal reference signal source with low impedance input and output coupling circuits, new Sierra Model 219A Transistor Tester provides, for the first time, measurement of transistor Beta on an in-circuit basis. Beta and Ico parameters may also be measured with the transistor disconnected.

Since testing may be done without energizing equipment under test, there are no spurious signals to confuse results and hours of trouble-shooting and service time are saved.

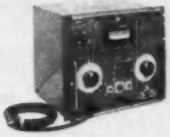
Model 219A is compact, rugged, conservatively rated and built of high quality components throughout. Request Bulletin from your Sierra representative or write direct.

Other new Sierra equipment



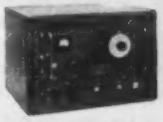
Model 218A Monitor Oscilloscopes

These new instruments are designed for continuous function monitoring of up to 7 channels simultaneously in one rack unit. Rugged and compact, they provide in the smallest possible package a convenient means for viewing and evaluating complex voltages. Ideal for measurements of stress, strain, vibration, pressure, displacement, acceleration and other quantities through a transducer.



Calorimeters, Water Loads

Sierra offers two groups of Calorimeters and Water Loads for both waveguide and coaxial measurements. Calorimeters and associated Loads provide measurements covering SL, S, XB and X bands.



Power Sources 25 to 1,000 MC

For fast, accurate calibration of power monitors and termination wattmeters. Output power adjustable 20% to 100% of rating; 50 watts output. Four models cover 25 to 1,000 MC in varying band spreads.

Data subject to change without notice

SIERRA ELECTRONIC CORPORATION

A Subsidiary of Philco Corporation

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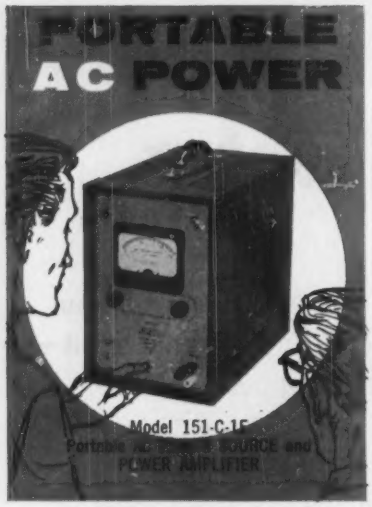
CIRCLE NO. 187 READER SERVICE CARD 187



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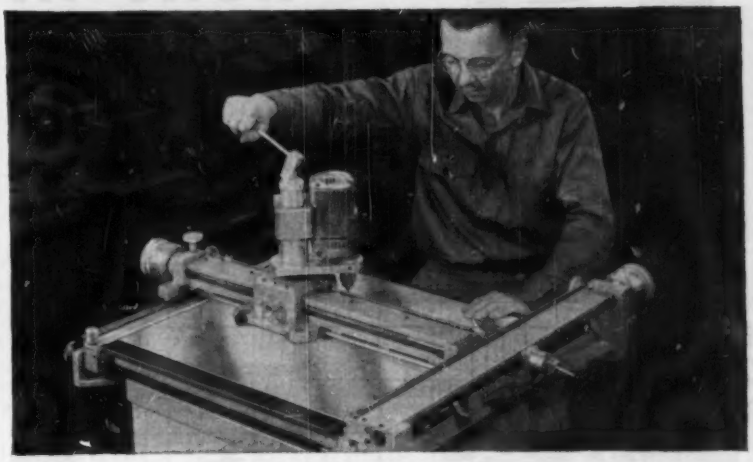

THE NEW **STRIPPIT FLEX-O-DRILL**

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- **LASTING ACCURACY!** Table is an actual ground surface plate. Bridge assembly is of heavy, accurately machined castings. Lead screws are precision ground and engaged only during micrometric gauge settings to minimize wear. All parts are corrosion-resistant. Bearings are protected against dust and chips by felt shields. Drill motor is heavy-duty industrial type.
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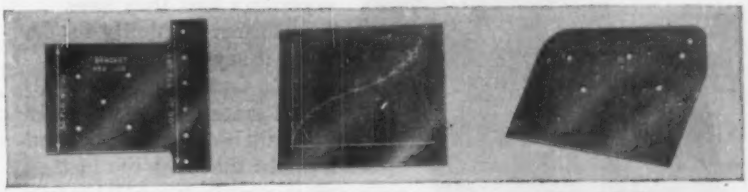

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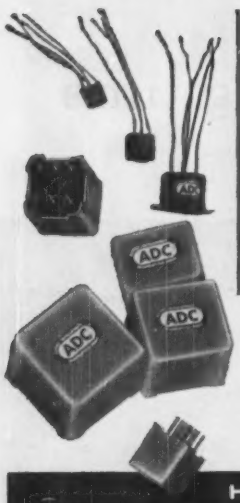
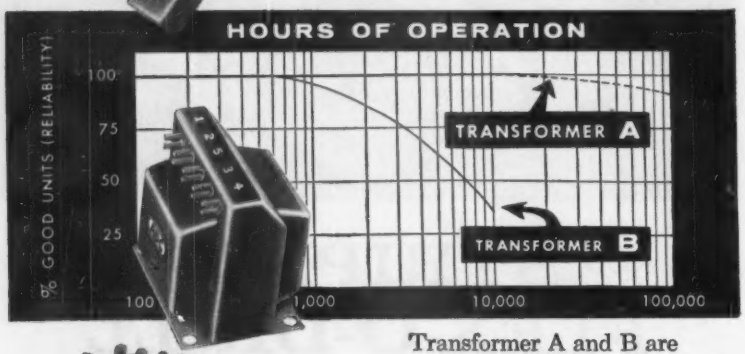
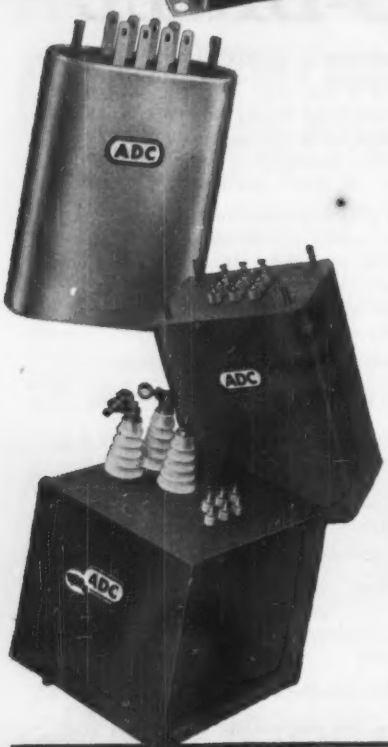


Long Life RUNS IN THE FAMILY!

Transformer A in the chart will deliver ten times more hours of dependable performance than transformer B. An engineer designing for reliability over a long period will want transformer A.





Transformer A and B are identical in appearance. They can both pass electrical inspection tests. The quality of the materials, workmanship, and design are all hidden from view so that no physical inspection can be made. So how do you tell? Which is A, and which is B?

The best way to tell is to know the manufacturer. If you're not already a customer we'd like to number you among those who *know from experience* that they have transformer reliability *inside*, when it says ADC on the *outside*. Over 15,000 custom transformer designs in nearly 25 years have proven beyond a doubt that long life just plain runs in the ADC family.

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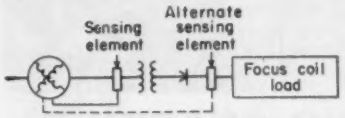
GENERAL ELECTRIC VOLTAGE REGULATION IDEA FILE

By C. A. NEUMANN

FOR RADAR ENGINEERS

General Electric Inductrol* regulators accurately control current to transmitter tube focus coils

Power input to transmitter tube focus coils on radar systems must be very closely regulated to assure proper operation of the tubes. The circuit below illustrates a typical application with a General Electric Inductrol voltage regulator accurately controlling the input to the focus coils.



In low-voltage power supply circuits the Inductrol regulator functions to control voltage. In focus coil applications, however, the Inductrol regulator is now called upon to precisely control the *d-c current.*

Here again, the ability of an induction voltage regulator to perform this regulation function can best be shown by the following example:

Maintain constant d-c current at any level within range of 9.5 amps to 6.3 amps. Corresponding d-c voltage levels for these current limits are as follows: @ 9.5 amps DC — 200 volts DC; @ 6.3 amps DC—98 volts DC; max. load — 1.9 kw. Regulator must withstand 25 times normal current (for 2 sec.) and introduce no harmful waveform distortion.

Input line supply: three-phase, 60 cycles, 208Y volts, with ± 10% voltage variation.

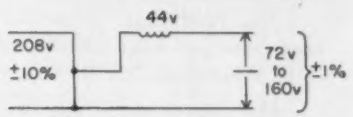
Rectifier: full wave, three-phase, silicon rectifier bridge, with system regulation of approximately 8%.

TO COMPENSATE FOR SYSTEM REGULATION, the regulator must be capable of delivering a maximum of 200 × 1.08=216 volts DC.

Using the proper conversion factors for a three-phase, bridge rectifier circuit, the corresponding d-c current and voltage values for the d-c counterparts will be as follows:

Voltage: 216 × .74=160 volts AC line to line
98 × .74=72.5 volts AC line to line
Current: 9.5 × .82=7.8 amps AC line

The range of regulation the Inductrol regulator must introduce into the circuit results in a requirement of plus and minus approximately 40% voltage range from the mid-point level of the output voltage range required. This considers input line variations and system regulation. Since the range of voltage output of the regulator (72.5 to 160 volts AC) is below the input voltage of 208 volts, a unique design technique in winding construction must be used for best economy. The sketch shows the basic regulator schematic circuit.



Further calculation will show that the regulator rating required to meet this focus coil requirement will be approximately

$$\frac{44 \text{ volts} \times 7.8 \text{ amps} \times \sqrt{3}}{1000} = 0.6 \text{ kva}$$

With this unique winding arrangement for these very special loads, it becomes possible to perform the desired voltage regulation without need for a separate stage of voltage transformation. In addition the Inductrol regulator will withstand 25 times normal current and does not introduce harmful waveform distortion.

For more information, write Section 425-22, General Electric Co., Schenectady 5, N.Y.

*Registered trademark of General Electric Co. for Induction Voltage Regulator.

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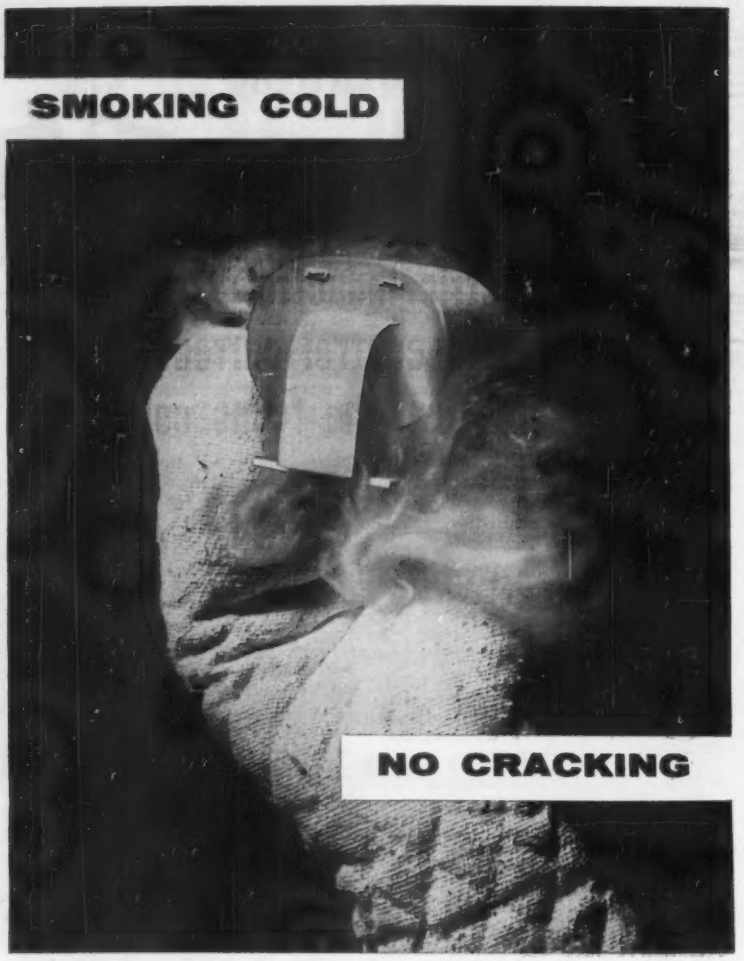

This transformer cast with a HYSOL 6700 series, one-component epoxy, has just been removed from a cold box set at minus 60°C. IT IS SMOKING COLD!

The purpose of the test — to determine if the coating could be destroyed by ultra-severe thermal shocking (—60°C to +150°C). The result, after repeated cycles exceeding the requirements of MIL-T-27A, Class S, THERE WERE NO CRACKS or sign of breakdown.

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4 DEGREES OF FLEXIBILITY
WILL OPERATE OVER 2000 HOURS AT 150°C.
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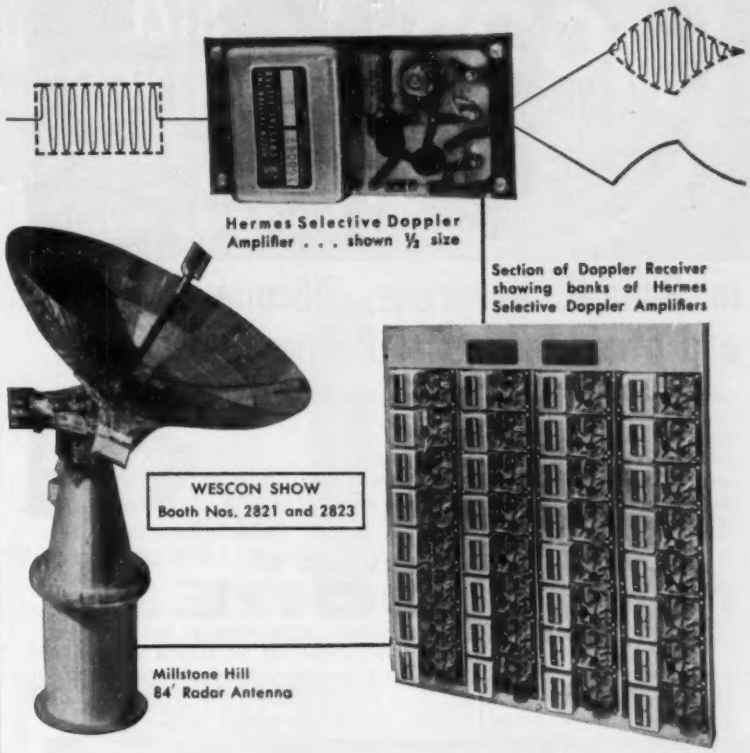
FIRST Radar System to Contact Venus Uses HERMES CRYSTAL FILTERS


Hermes Selective Doppler Amplifier . . . shown ½ size
Section of Doppler Receiver showing banks of Hermes Selective Doppler Amplifiers
WESCON SHOW
Booth Nos. 2821 and 2823
Millstone Hill
84' Radar Antenna

Contact with Venus, a distance of 28,000,000 miles, was made by Lincoln Laboratory's powerful Millstone Hill Research Radar using low noise solid state maser preamplifiers. Exact pulse output and sharp noise rejection are made possible in the Millstone system through the use of Hermes "Comb Set" Crystal Filters and associated circuitry forming complete networks termed Selective Doppler Amplifiers.

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Hermes is presently supplying crystal filter banks for airborne intercept, bomber defense, shipborne and land based detection and tracking systems. *Write for Crystal Filter Bulletin.*

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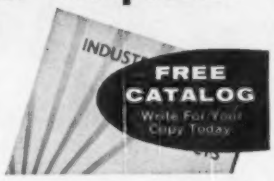

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FEATURES:

- Pure metal foil now laminated to the inner surface of Zippertubing for immediate shielded cable.
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- Permits emergency and maintenance repair modifications in the field.
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- Offered with overlap construction for 100% coverage protection.
- May be stored in flat form with sizes from ½" I.D. up.

A strong, durable, yet flexible shielded cover can be applied in minutes. With Shielded Zippertubing a manufacturer can create his own shielded cable at a fraction of the cost and approximately 1/10 of the delivery time. The normal time and labor spent in encasing cables and wire harnesses can be reduced by as much as 90%. No special equipment necessary.

Three ranges of shielding available; light-aluminum, medium-lead, heavy duty-magnetic foil.

SPECIFICATIONS:

Wall Thickness:
.020, .040, .060 AWG

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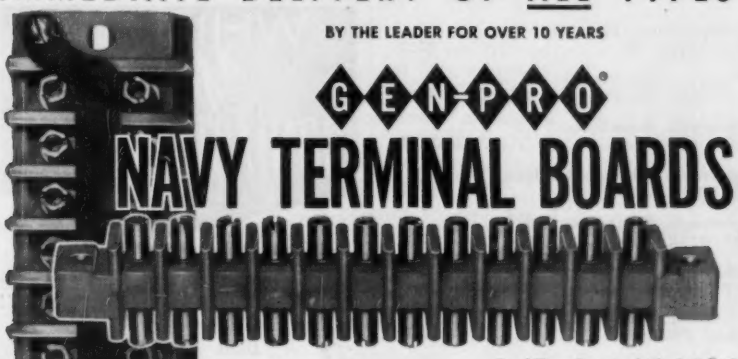

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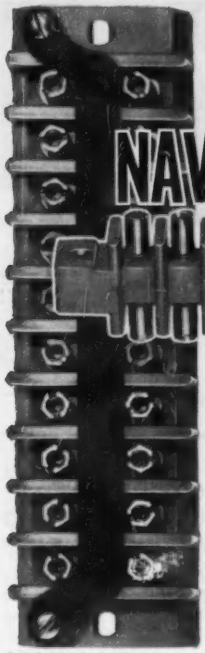

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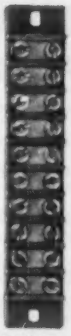

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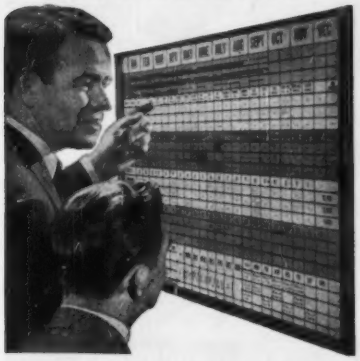

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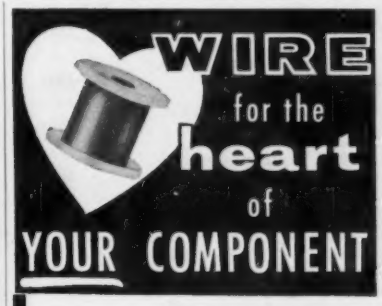

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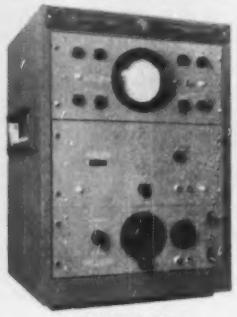

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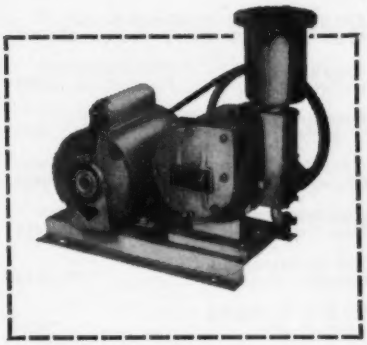

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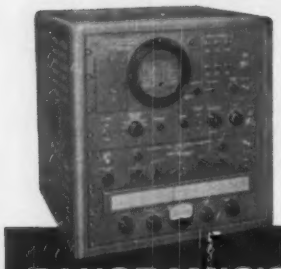

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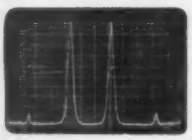

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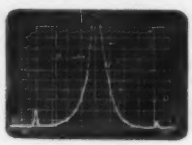

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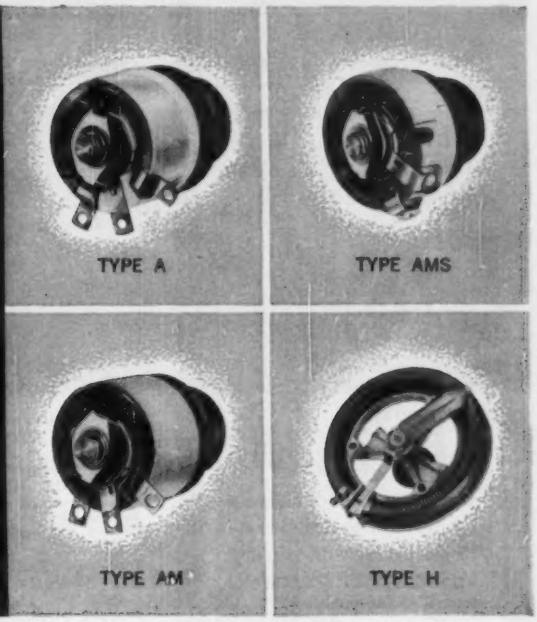

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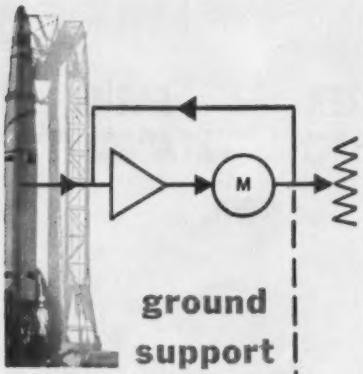

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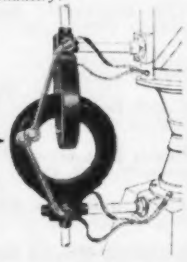

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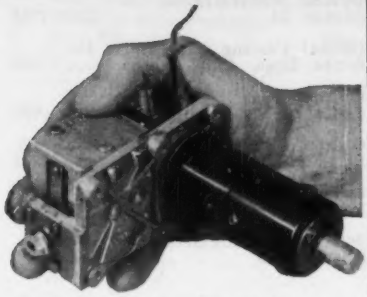

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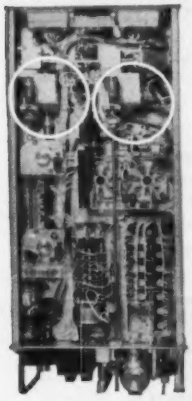

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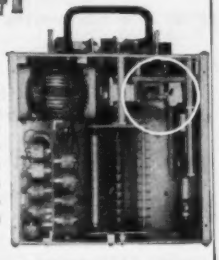

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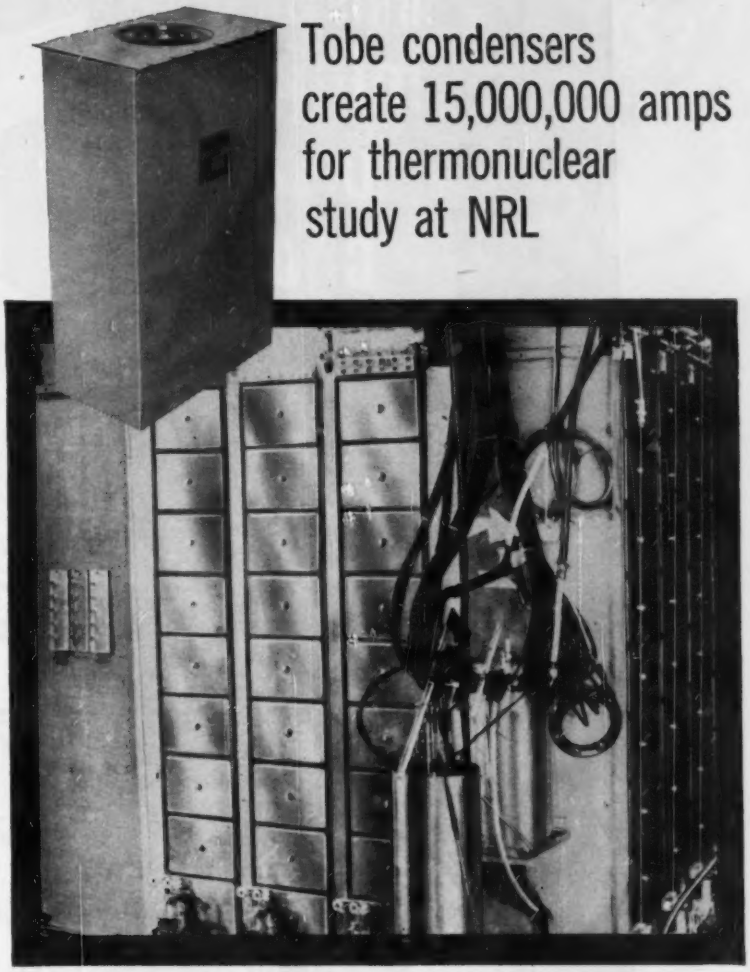

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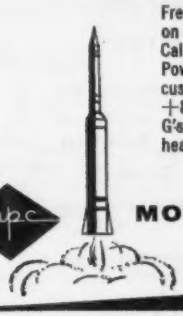

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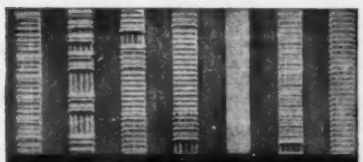

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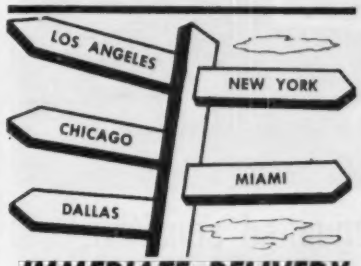

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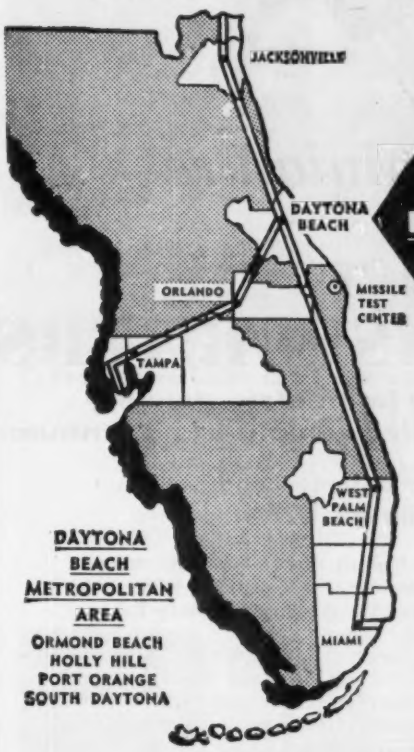

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UME-15	output	1200	3.2
UME-16	output	10,000	3.2
UME-18	choke	3 hy @ 2 Madc	—
UME-19	output or driver	10,000 CT/12,500 CT	500 CT/600 CT
UME-20	driver	10,000/12,500	1200 CT/1500 CT
UME-21	driver	10,000/12,500	2000 CT/2500 CT
UME-22	single or PP output	150 CT/200 CT	12/16
UME-23	single or PP output	300 CT/400 CT	12/16
UME-24	single or PP output	600 CT/800 CT	12/16
UME-25	single or PP output	800 CT/1070 CT	12/16
UME-26	single or PP output	1000 CT/1330 CT	12/16
UME-27	single or PP output	1500 CT/2000 CT	12/16
UME-28	single or PP output	7500 CT/10,000 CT	12/16
UME-29	output	300 CT	600
UME-30	output	500 CT	600
UME-31	output	900 CT	600
UME-32	output	1500 CT	600
UME-33	interstage	20,000 CT/30,000 CT	800 CT/1200 CT
UME-34	input	200,000 CT	1000 CT
UME-35	interstage	10,000 CT/12,000 CT	1500 CT/1800 CT
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36VCT 16VDC 32.50	24.50	36.75	55.13	82.69	124.04	186.05	279.08
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144VAC 64VDC 37.50	28.25	42.38	63.56	95.34	143.01	214.52	321.78
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140VAC 112VDC	58.25	72.81	94.65	130.68	196.03	294.05	441.08	661.61	882.15	1102.69
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560VAC 448VDC	77.90	97.38	126.59	174.79	262.19	393.28	589.93	884.89	1179.85	1474.81
1120VAC 896VDC	104.10	130.13	169.16	233.60	350.40	525.60	788.40	1182.60	1576.80	1971.00
1400VAC 1120VDC	117.20	146.50	190.45	262.95	394.43	591.65	887.48	1331.21	1774.95	2218.69
1680VAC 1344VDC	130.30	162.88	211.74	292.30	438.45	657.68	986.51	1479.77	1973.03	2466.29
2240VAC 1792VDC	156.50	195.63	254.31	351.20	526.80	790.20	1185.30	1777.95	2370.60	2963.25
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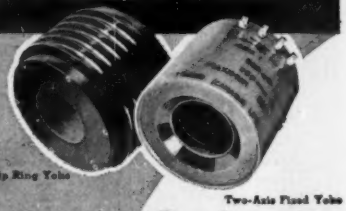

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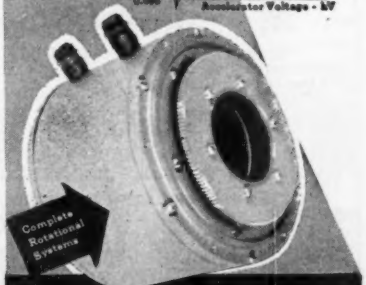

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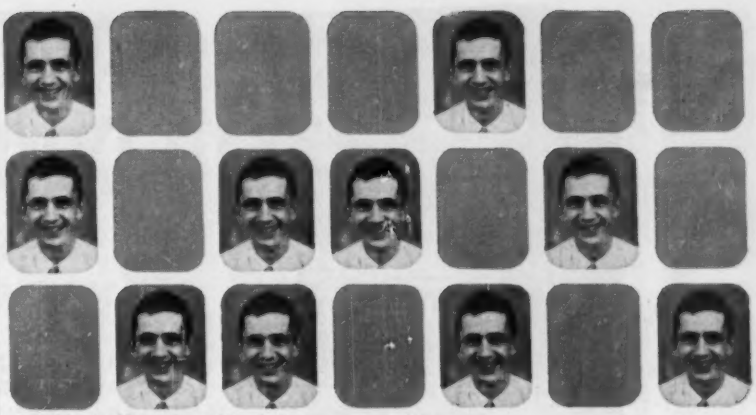

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Pennon Electronics, Inc., Bell Gardens, Calif., names **Key Electronics, Inc.,** Hollywood, Calif., as its sales rep in southern California, Arizona and Hawaii.

Hoffman Laboratories Division, Los Angeles, Calif., signs two eastern reps to handle its electromechanical products:

Hart Engineering & Sales Co. of Atlanta, Ga., covers Florida, Georgia, North and South Carolina, Mississippi, Tennessee, Alabama, and Baton Rouge and New Orleans, La.; **Wild & Associates, Inc.** of Roslyn, L. I., N. Y., serves New York, New Jersey, Connecticut, Maryland, Delaware, Washington, D. C., and eastern Pennsylvania.

Thomson Engineering Service of Dallas, Texas, is appointed to represent Fairchild Controls Corp., Hicksville, N. Y., in Kansas and Missouri.

Weinschel Engineering, Kensington, Md., names **Bivins & Caldwell, Inc.,** of High Point, N. C., as sales engineers to cover Florida, Georgia, Alabama, Tennessee, North Carolina, Kentucky, West Virginia (except for eastern counties), and southern Virginia.

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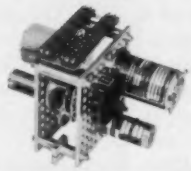

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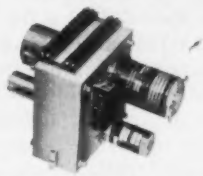

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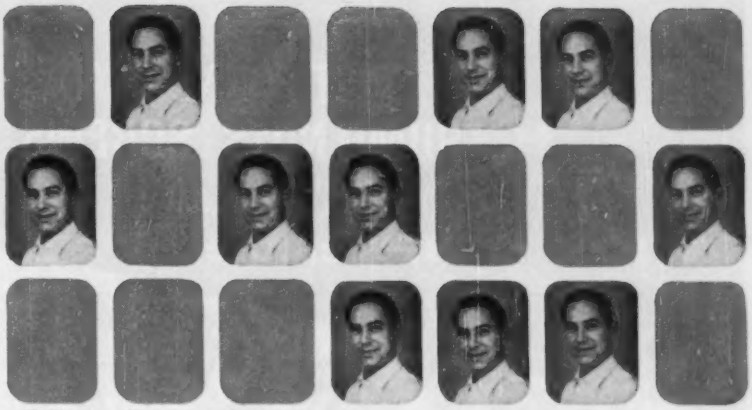

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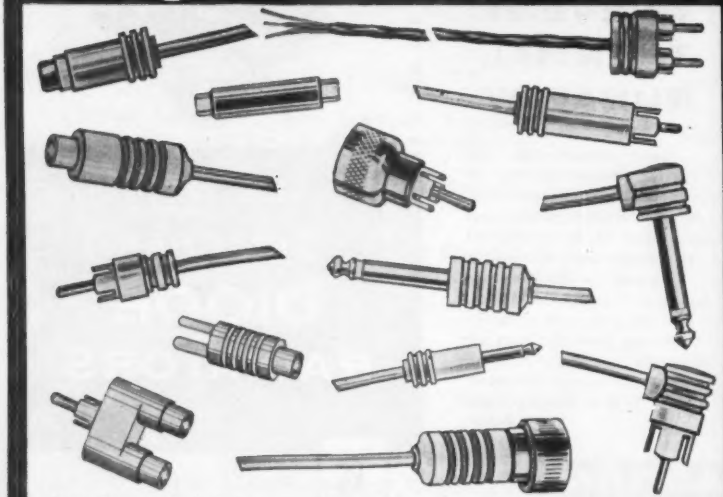

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COMMENT

Distortion

Re: "Distributed Amplifiers for Wide-Band Applications" by R. T. Stevens (p 64, June 19): In listing the characteristics of a number of commercially available distributed amplifiers, the author shows maximum output voltage figures that do not correctly present the relative performance of several of the amplifiers.

He shows an output of 45 v for the Entron RA-1B, 27 v for the Entron RA-1C, 0.45 v for the Jerrold LSA-795 and 3 v for the Spencer-Kennedy 211. Since these four amplifiers are all intended for tv distribution, cover approximately the same frequency range, and use somewhat similar tube components, such a wide range of output capabilities requires explanation.

If the author were dealing with hi-fi audio amplifiers, we would expect him to compare the power outputs of several amplifiers at a given level of distortion. This same logic should be applied to tv amplifiers. In actual use the output level from such an amplifier is limited by the tendency of one channel to cross-modulate on another, causing "windshield-wiper" effects. A statement of output power is only significant when the cross-modulation percentage is specified.

Our experience indicates that visible effects occur at approximately 0.2-percent cross-modulation. Although we have no way of knowing the distortion level at which the outputs of other amplifiers were measured, our LSA-795 delivers 0.45 v at 0.15-percent cross-modulation with five channels. The same amplifier will deliver more than 8 v if distortion is not considered.

It seems apparent from these considerations that the discrepancy between the output levels of these four amplifiers is primarily due to differing methods of measurement rather than to an actual difference in the amplifiers.

K. A. SIMONS
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Mr. Simons is correct in pointing out that cross-modulation distortion is a significant factor in deter-

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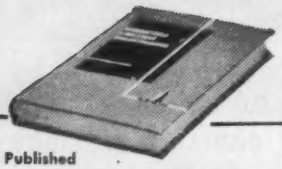

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mining maximum *usable* output. Since the literature furnished me by Jerrold made no mention of distortion levels, I chose to assume that the maximum output they specified was determined by maximum tube dissipation. I was interested to hear that this level was based on tolerable cross-modulation distortion.

An error crept into the figures for the Entron Amplifiers, which should have been 1.4 vrms maximum for both amplifiers. A comparable figure to that given by Jerrold is that of 0.1 vrms maximum with 0.1-percent intermodulation distortion for the Entron units. Similarly, the Spencer-Kennedy model 211 has a maximum output of 1.0 v with 0.5-percent intermodulation distortion.

ROGER T. STEVENS
ELECTRONICS SYSTEMS INC.
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Gremlin?

The diagram (Fig. 2 in "Double Integrator Finds Distance," p 64, May 22) causes me a puzzlement. The circuit marked *Signal Rectifier* seems to have a gremlin in it, unless it functions on some new principle which I do not understand.

I suspect that there is a drafting error of some kind here. This could be either that the circuit was mislabelled *Signal Rectifier* when it should have been *Signal Dumper* (in which case, why build the device?), or that one of the diodes is drawn hind-side-to.

RONALD L. IVES
PALO ALTO, CALIF.

. . . After translating the comment (with some difficulty, since I am English), I find that one of the diodes is indeed drawn backwards in the Signal Rectifier circuit.

I cannot excuse myself on the grounds that this slip is rather an obvious one, but I can assure (Mr. Ives) that if anyone whose technical competence is such that he is liable to be fooled by it, ever tries to make the circuit work, then he's in for a wonderful time when he starts adjusting and calibrating it.

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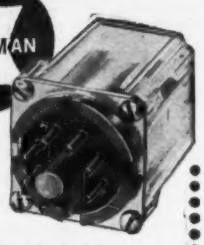

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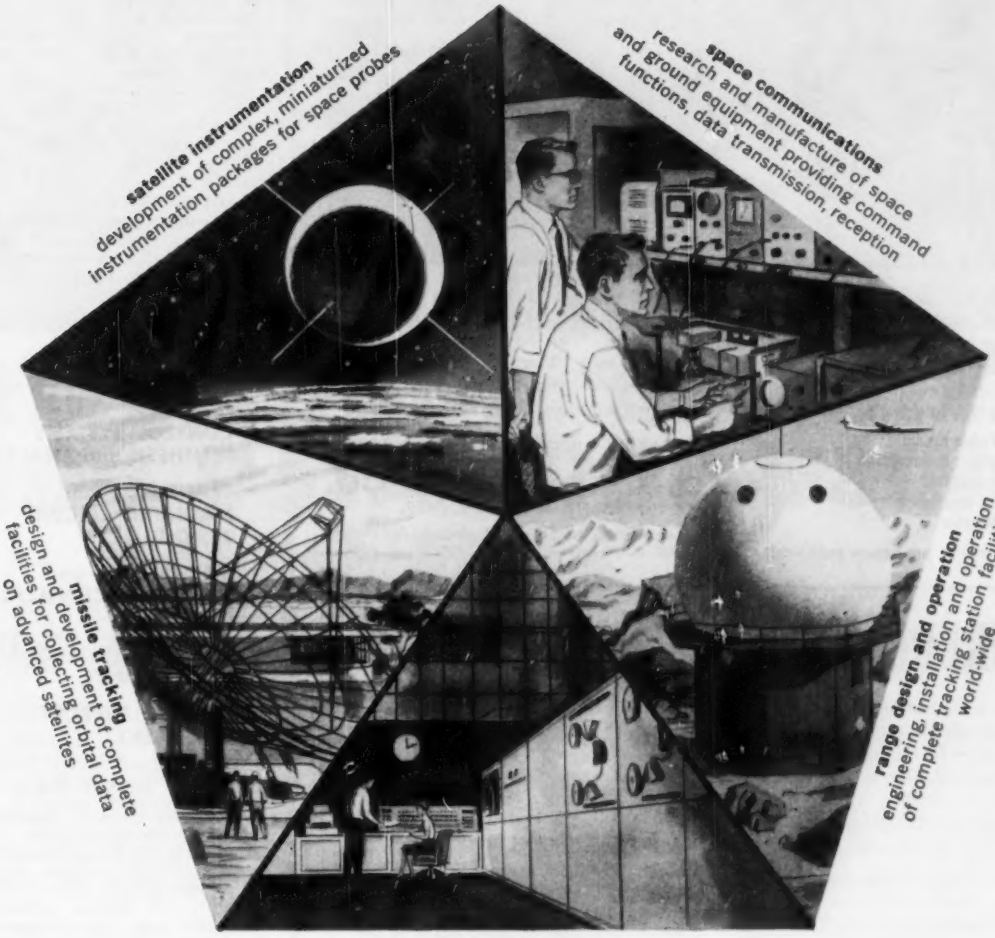
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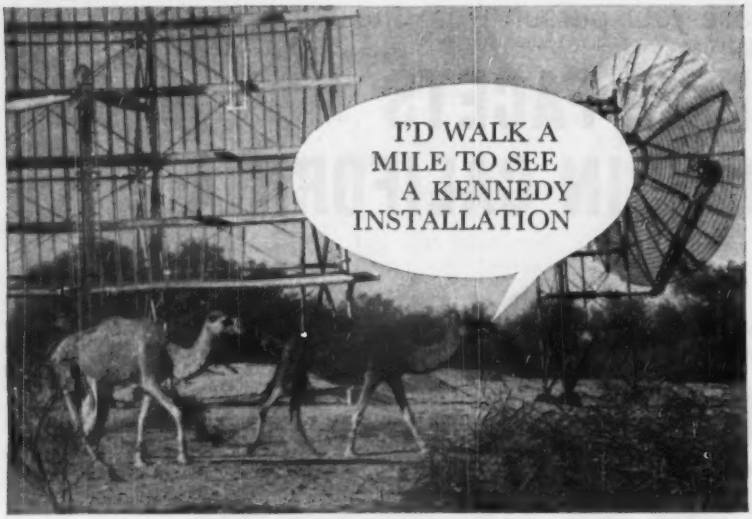

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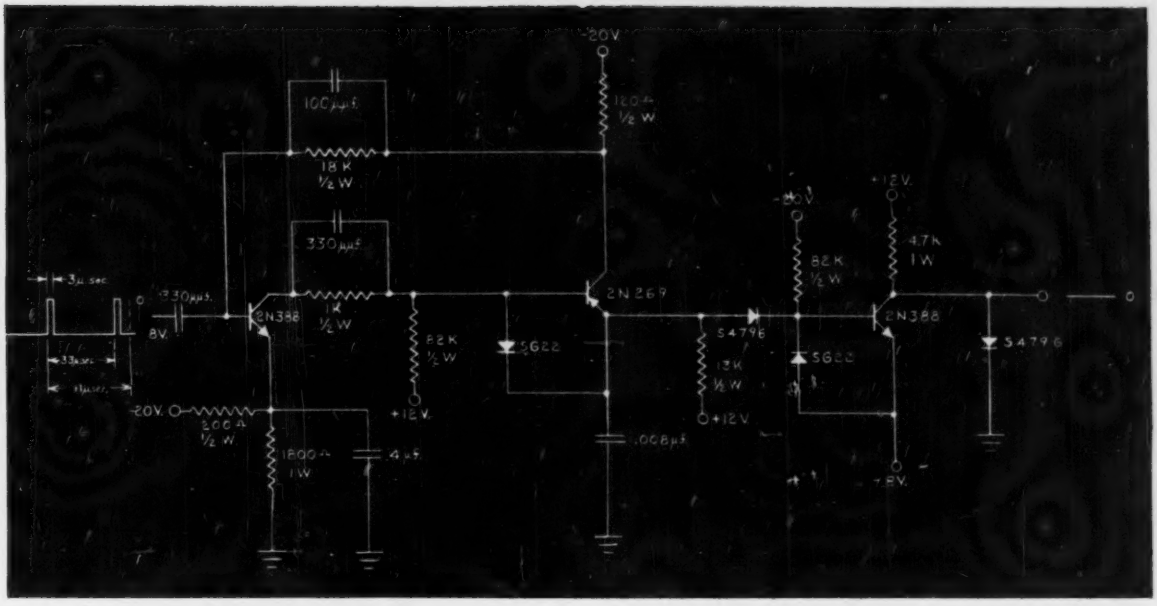

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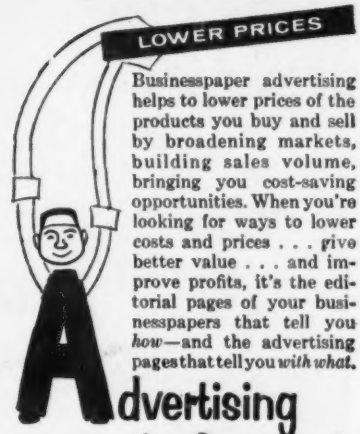
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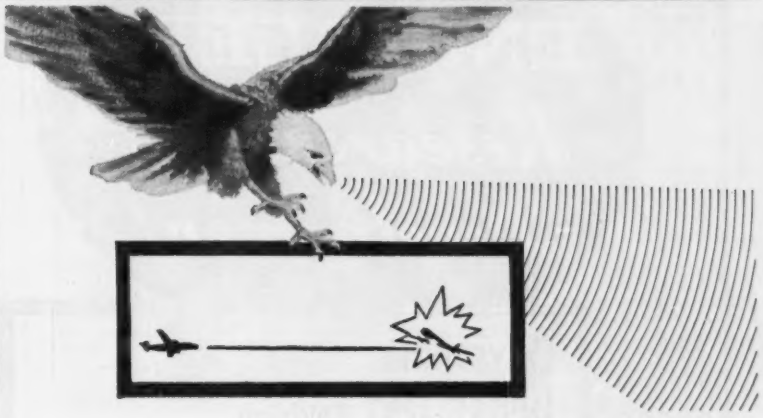

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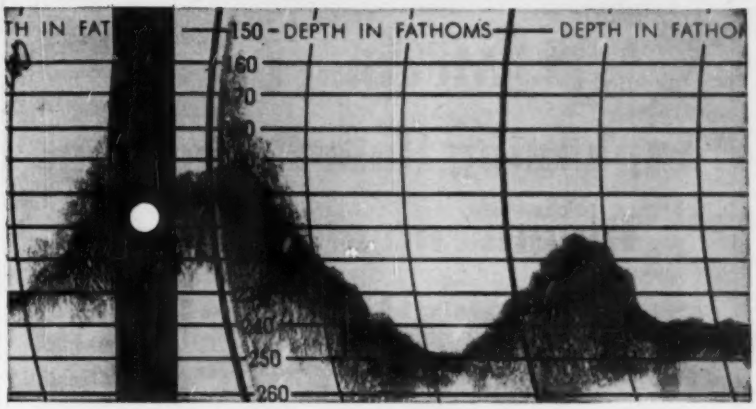

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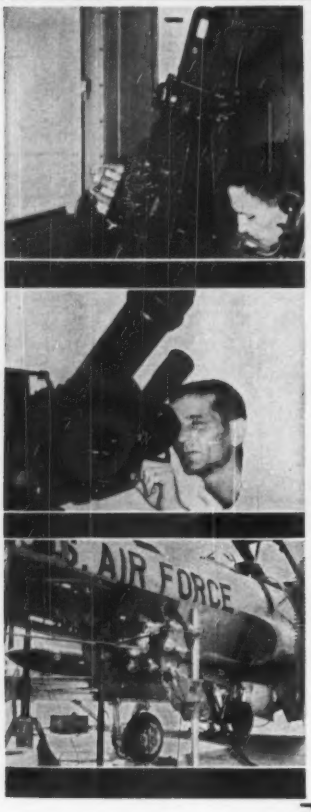

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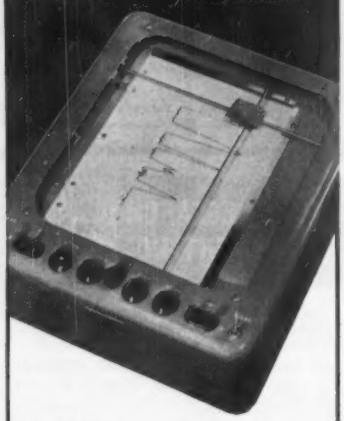

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Type MLS is an extremely high stability laboratory frequency standard. The clock on the panel facilitates easy checking of stability.

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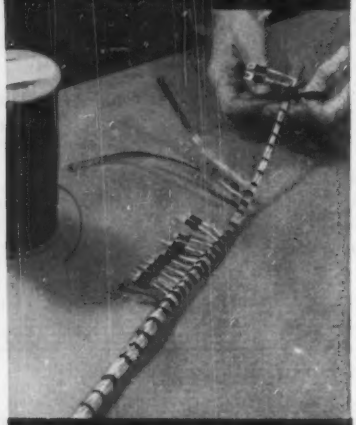

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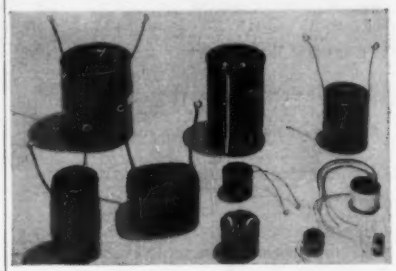

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